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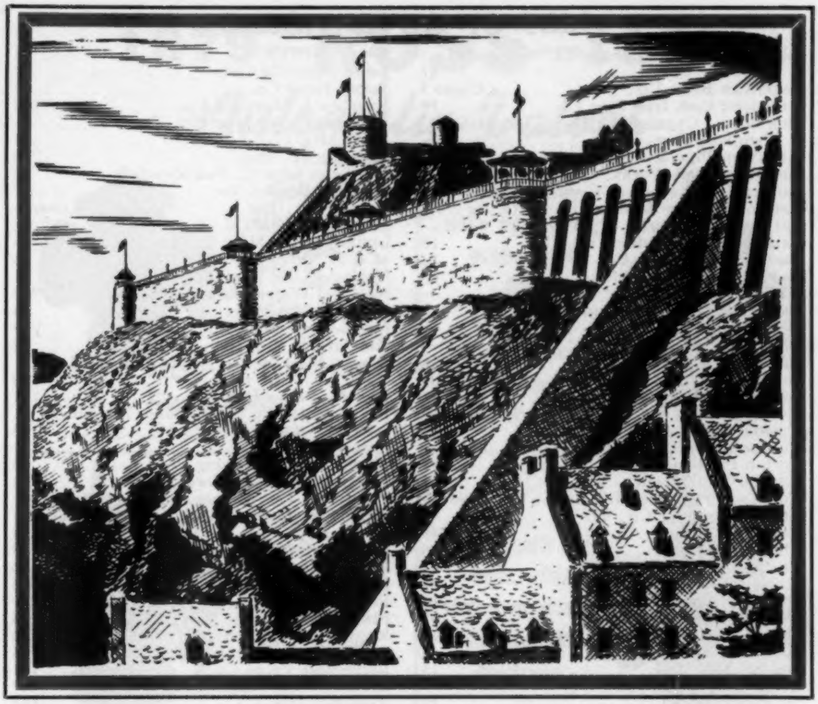

Quebec's famous Citadel, over 330 feet above the St. Lawrence, as it looked 100 years ago

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COMING MEETINGS

May 17–19—Pacific Northwest Section at Vancouver Hotel, Vancouver, B.C. Secretary: O. P. Newman, Secy., Boise Water Corp., Boise, Idaho.

21–23—Canadian Section at Royal Alexandra Hotel, Winnipeg, Man. Secretary: A. E. Berry, Ontario Dept. of Health, Parliament Bldgs., Toronto 2, Ont.

June 29—New Jersey Section Summer Meeting (inspection trip and luncheon), Trenton, N.J. Secretary, C. B. Tygert, Box 178, Newark 1, N.J.

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Journal
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A Method for Decontaminating Small Volumes of Radioactive Water

By R. A. Lauderdale and A. H. Emmons

A contribution to the Journal by R. A. Lauderdale, Associate Health Physicist, and A. H. Emmons, Jr. Chemist, Health Physics Div., Oak Ridge National Laboratory, Oak Ridge, Tenn.

RECENT investigations into the decontamination of radioactive liquids at Oak Ridge National Laboratory have led to the development of a compact decontamination unit which can be adapted to purify emergency drinking water supplies. With this device, water which was made extremely radioactive by the addition of a complete mixture of fission-produced radioisotopes, was treated to give a product containing less than 10^{-4} microcuries (μc.) of activity per ml. This concentration of radioactivity is approximately one hundredth the maximum concentrations—of the order of 10^{-2} μc. per ml. for both alpha and beta contamination—suggested (1, 2, 3) as acceptable for emergency use during a 7–10 day period. Although experimental work has not yet been completed, the interest shown in these findings has persuaded the authors to issue a report on work to date.

The decontamination treatment which has been found to be most effective consists in passing the radioactive water through the following materials, arranged in series: steel wool, burnt clay, activated carbon and a mixture of ion exchange resins. Two columns, each ¾ in. in diameter and 26 in. long, were so arranged that the water flowed up through the first section and down through the second. The first section contained 50 g. of grade 0 steel wool, packed into 15 in. of column length; 37 g. of calcined clay packed into 8 in. of column; and 12 g. of activated carbon packed into 3 in. of column. The second section of the unit was packed to a depth of 26 in. with a mixture of quaternary amine-polystyrene (strong base) type anion-exchange resin and nuclear-sulfonic polystyrene (strong acid) type cation-exchange resin.

Preparation of Feed

The diluted feed was prepared by adding tap water to a 60-hour-old solution of fission-produced radioisotopes to give a radioactivity concentration of

approximately 2.5 μc. per ml. of feed. As the stock solution was highly acid, it was evaporated to dryness to expel most of the acid. The feed was adjusted to the pH of tap water (7.5) by adding NaOH. Table 1 gives an ionic analysis of the Oak Ridge tap water which was used to prepare the feed solutions. The feed did not contain fission products in the same ratio as would be found following a bomb blast, but it did contain portions of all the radioisotopes that would be present.

TABLE I

Ionic Analysis of Feed Water *

Constituent	Concentration *ppm.*
Alkalinity as $CaCO_3$ (phenolphthalein)	2
Alkalinity as $CaCO_3$ (methyl orange)	90
Soap hardness as $CaCO_3$	90
Dissolved CO_2	3
Dissolved solids	120
Nonvolatile solids	80
SiO_2	6
Ca	25
Mg	8
Na	6–8
SO_4	30
Cl	6
CO_2	54
HCO_3	115

* With pH value of 7.5.

The results obtained were, therefore, considered to be representative of the decontamination that could be secured under actual emergency conditions, such as might result from a bomb burst or from direct contamination with fission products.

The effects of flow rate and resin depth, the efficiency of resin used alone and the effectiveness of each component, as used in the apparatus, were among the operating factors studied. The end-point of each run was arbitrarily designated as that volume at which the radioactivity in the effluent exceeded 10^{-4} μc. per ml.

Flow rates varying between 0.4 gpm. per sq.ft. of column area to 5.0 gpm. per sq.ft. were used. It was found that in this range neither the efficiency of removal nor the total capacity of the unit was affected. Indications were that even higher flow rates could be employed.

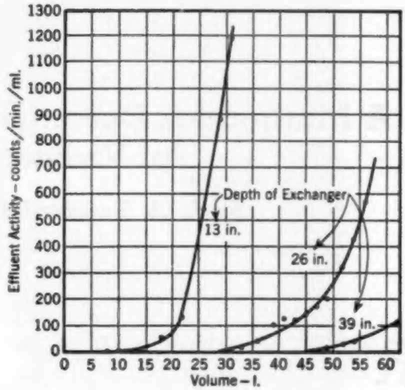

Fig. 1. Activity of Effluent as a Function of Volume

A flow rate of 2.95 gpm. per sq.ft. was used in this test with a feed containing approximately 2.5 μc. per ml. of radioactivity. Results indicate that the volume of water which can be treated before effluent activity exceeds any given quantity is almost directly proportional to the total volume of resin used. This suggests the possibility of using extremely small units to treat small volumes of water.

The effect of the resin depth is illustrated in Fig. 1. A flow rate of 2.95 gpm. per sq.ft. was used in this test with feed containing approximately 2.5 μc. per ml. of radioactivity. Results indicate that the volume of water which can be treated, before effluent activity

exceeds any given quantity, is almost directly proportional to the total volume of resin used. This suggests the possibility of using extremely small units to treat small quantities of water. As yet, no studies have been made of columns containing resin depths of less than 13 in.

Radioactivity of Effluent

Figure 2 compares the radioactivity of the effluent from a resin column used alone and that from a resin column used in conjunction with steel wool, clay and carbon. Leakage from the resin column which was used alone was apparent almost immediately; the end-point of 10^{-4} μc. per ml. (equivalent to 10 counts per minute per ml.) was exceeded at about 3 l. With the complete unit, however, 28 l. were processed before the effluent activity exceeded 10^{-4} μc. per ml. At 25 l. the resin column had broken completely, whereas at the same volume the effluent activity of the complete unit was still considerably lower than 10^{-4} μc. per ml., although a gradual breakthrough was beginning to take place. The activity of the effluent increased slowly until at about 40 l. it leveled off to approximately 5×10^{-4} μc. per ml., a radioactivity lower by a factor of twenty than the maximum permissible emergency concentration. Up to about 28 l. the effluent remained essentially deionized with a pH of nearly 7.0. As radioactivity began to increase, however, a simultaneous drop in pH occurred, and small quantities of solids were found in the liquid. This performance is to be expected as the resin becomes depleted. The pH of the effluent at 40 l. was approximately 4.3. That no sharp breakthrough occurred with the combined assembly can be attributed to the effectiveness of the steel wool, clay and carbon in removing radio-ions which normally leak through the mixed resin column and to the continued adsorption of higher valence cations by the cation resin.

Although the active emitters in the effluent have not yet been identified, absorption and decay curve analyses indicated that at least three components were present. The absorption curve showed that, of total effluent activity, about 6.0 per cent had an energy of 1.9 million electron volts (Mev), 56 per cent had an energy of 0.7 Mev., and 28 per cent had an energy of approximately 0.4 Mev. A decay curve of the same effluent activity indicated the presence of isotopes with half-lives of 5 hours, 15 hours, and 65 days. Using an evaporated sample in a standard alpha counter, 0.07 disintegrations per minute

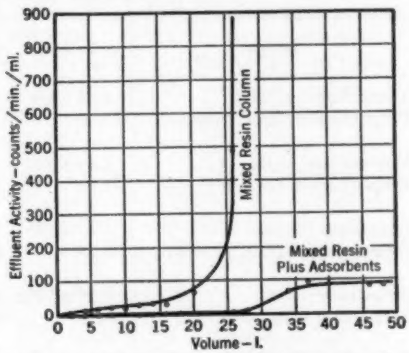

Fig. 2. Comparison of Treatment by Ion Exchange Alone and by Complete Unit

The activity of the effluent from a resin column used alone and that from a resin column used in conjunction with steel wool, clay and carbon are compared in the above figure. A flow rate of 35 ml. per minute was used with a feed containing approximately 475,000 counts per minute per ml. (2.5 μc. per ml.)

per ml. of alpha activity were found to be present in 36 l. of water.

Removal of Fission Products

The efficiency of steel wool in removing fission products from water is apparent from the data given in Table 2. This table contains the results of radiochemical analyses of the activity eluted from each component following a test in which a month-old fission product solution was used. The efficiencies shown therefore are those of isotopes of long half-life. As indicated by the table, 85.3 per cent of the radioactivity was removed by the steel wool, 12.0 per cent by the clay, 0.8 per cent by the carbon, 1.9 per cent by the cation exchangers, and 0.2 per cent by the anion exchanger. The percentage of each isotope removed by the various components is also shown. With the 60-hour-old mixture of isotopes, the steel wool removed approximately 86.3 per cent of the total radioactivity, the clay and carbon combined, 2.5 per cent, and the mixed resin approximately 11.3 per cent.

TABLE 2

Radiochemical Analysis of Activity Adsorbed by Decontaminants

Isotope	Steel Wool	Burnt Clay	Activated Charcoal	Cation Resin	Anion Resin
Total Beta—*c./m.**	2.35×10^9	3.3×10^8	2.21×10^7	5.28×10^7	5.87×10^6
Proportion of total Beta—%	85.26	11.99	0.80	1.92	0.21
Ruthenium—*c./m.*	4.43×10^7	1.67×10^6	6.53×10^4	8.89×10^4	4.0×10^4
Proportion of total Ru—%	95.96	3.62	0.14	0.19	0.09
Zirconium—*c./m.*	1.72×10^8	7.37×10^5	1.05×10^5	1.87×10^5	3.06×10^4
Proportion of total Zr—%	99.39	0.43	0.061	0.108	0.018
Strontium—*c./m.*	3.19×10^8	8.36×10^7	1.63×10^7	3.83×10^7	3.69×10^6
Proportion of total Sr—%	69.72	18.27	3.56	8.37	0.81
Total Rare Earths—*c./m.*	1.54×10^9	2.31×10^8	1.64×10^6	1.21×10^6	5.94×10^4
Proportion of total R.E.—%	86.81	13.02	0.09	0.06	0.003
Cerium†—*c./m.*	6.81×10^8	1.99×10^7	2.34×10^4	1.51×10^5	1.36×10^4
Proportion of total Ce—%	97.13	2.84	0.003	0.02	0.002
Cesium—*c./m.*	2.39×10^6	1.60×10^6	None found	5.72×10^3	5.06×10^3
Proportion of total Cs—%	59.74	39.99	0.0	0.14	0.13
Niobium—*c./m.*	6.99×10^6	4.10×10^4	8.25×10^3	3.12×10^4	1.14×10^4
Proportion of total Nb—%	98.7	0.58	0.12	0.44	0.16
Tellurium—*c./m.*	1.15×10^7	1.05×10^5	2.3×10^4	2.77×10^4	3.87×10^4
Proportion of total Te—%	98.34	0.89	0.19	0.237	0.331

* Counts per minute.
† Cerium is also included in total rare earths.

The specific actions of all the materials employed in the unit have not yet been established. Steel wool was added primarily to remove ruthenium,

for which it had been found to be very effective, and possibly other noble metals. Its effectiveness in removing large percentages of other isotopes was not expected. The hypothesis has been advanced that steel wool serves both as a reducing agent, with a subsequent plating taking place, and as a medium for the adsorption of radio-colloids, many of which exist at the pH of the tap water used. It was found that radioactivity could not be removed from the steel wool merely by washing it with water, thus ruling out the possibility that its action was the simple, mechanical one of floc filtration. A dilute HCl solution was more successful in removing the radioactivity efficiently in preparing the steel wool for further use.

During operation, a band of rust, caused by oxidation of the iron by air in the water, appeared at the bottom of the column. No difficulty resulted from this, however, as the progress of the rust band up the column was very slow. It was found that plugging of the column occurred if fine iron filings were used in place of the steel wool, or if an extremely fine grade of steel wool were used. It should be possible, however, to use a coarse grade of iron chips, or possibly another metal in granular form, and benefit by the greater ease of packing which they afford.

The burnt clay was found, through tracer runs with both natural and prepared earths, to be highly efficient in the adsorption of cesium, and to a lesser extent, strontium. It also served as a filter and adsorbent for the small quantities of iron which were removed from the steel wool. The carbon was added primarily for taste, odor and color control, as well as for the removal of small quantities of radioactivity. A number of ion-exchange resins are available which will serve equally well. In general, these should be of the strong base and strong acid types to effect greater salt-splitting and faster reactions.

Conclusion

It has been found possible to decontaminate a highly radioactive water to a level well below the emergency concentration permissible for drinking purposes by means of a compact unit constructed of readily available materials. Because the principal radioisotopes in the effluent obtained by this method from a recently produced mixture of fission products appear to be relatively short-lived, a concentration of 10^{-4} μc. per ml. presents little biological hazard.

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The authors are indebted to the Permutit Co., New York, N.Y.; the Rohm and Haas Co., Philadelphia, Pa.; the National Aluminate Corp., Chicago, Ill.; and the Dennison Mfg. Co., Asheville, N.C., which furnished samples of materials; and to the large number of persons at the Oak Ridge National Laboratory who contributed to the work reported here.

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A New Water Supply for the Alexandria Water Company

By E. H. Aldrich

A contribution to the Journal by E. H. Aldrich, Chief Engineer, American Water Works Service Co., Inc., Philadelphia, Pa.

RARELY in these times does the opportunity come to promote, plan, construct and operate an entirely new water supply system. In the past several years, the Alexandria Water Co., serving Alexandria and the surrounding area of Virginia, has had that opportunity. In the resultant new 4-mgd. plant are several novel features which may be of special interest to the water works profession.

A number of factors created the need for a new water supply. Alexandria's former supply had been secured from Cameron Run, a stream with a rather small drainage area of 33 square miles. At the headwaters, on Holmes Run, was an impounding reservoir holding 817 mil.gal. Continuing growth in the area was rapidly populating the watershed. More important, it was found that trunk and intercepting sewers laid adjacent to the streams constituting the source of the water supply were materially depleting the reservoir and streams through infiltration. In dry periods such infiltration might seriously reduce the safe yield of water below the amount required to serve even the existing service area.

In addition, the growth of adjacent Fairfax County was being retarded by the lack of an adequate water supply system. To expand the service area throughout the southern part of Fairfax County would require a substantial additional source of water. Well yields were not satisfactory except in limited areas and even in those areas a dry period might well demonstrate their inadequacy.

In the area under consideration, there were three streams which were considered for development—the Accotink, Pohick and Occoquan Creeks. The first of these streams was already in limited use as a source of water for Fort Belvoir, located at the confluence of Accotink Creek and the Potomac River. Both the Accotink and Pohick Creeks have small drainage areas, and the amount of storage which would be necessary to provide a dependable supply for the area made both these streams uneconomical of development except as an addition to the existing supply. Furthermore, any new development would have to provide for considerable future growth in the area to be served.

Occoquan Creek, flowing into the Potomac River at Woodbridge about 20 miles south of Alexandria, has a drainage area at tidewater of about 550 square miles. With its branches—Bull Run of historical fame, and Broad and Cedar Runs—Occoquan Creek flows through relatively sparsely popu-

lated farm and wooded lands. Manassas is the largest community in the area and it is located about 15 miles upstream, off the major streams. Approximately fifteen years earlier, there had been a small power development 7 miles above tidewater. A part of this project, a dam impounding an estimated $1\frac{1}{2}$ to 2 bil.gal., was lying idle at the time the new project was under consideration. A power development had been projected at tidewater 50 years earlier and considerable land and rights were assembled, but no work was ever carried through. The Alexandria Water Co. purchased the rights and property, thereby securing the rights to the full flow of Occoquan Creek at tidewater with a fairly large impounding reservoir some distance upstream. This provided an acceptable supply, capable of expansion, which would furnish a water supply for the area for many years to come.

During the past year and one-half, construction of the following units was completed:

1. A dam and intake located about 1,800 ft. above tidewater.
2. A conduit from the intake to the raw water pumping station, carrying water for both domestic use and power generation.
3. A raw water pumping station at tidewater.
4. A raw water transmission main.
5. A purification plant and high service pumping station.
6. A transmission main to Alexandria.

Dam and Intake

The intake is located about 1,800 ft. upstream from tidewater on the Occoquan near Occoquan Village, where a gravity, overflow type concrete dam was constructed across a rocky gorge. It is about 450 ft. long with a maximum height of about 30 ft. at its spillway level, an elevation of 52 ft. Flashboards raise the water an additional 3 ft. to an elevation of 55 ft., which will provide storage for about 55 mil.gal. The storage available upstream, in the reservoir formed by the power development dam—estimated at 1.5 to 2.0 bil.gal.—can be drawn upon as required.

The intake is composed of three compartments with coarse bar screens across their receiving ends. A fine mesh traveling screen is also included in the compartment supplying the raw water. The other two compartments form the head works for conveying water for power generation to the raw water pumping station.

Conduit

A three-compartment reinforced concrete conduit conveys the water approximately 2,000 ft. from the point of intake to the raw water pumping station adjacent to Occoquan Village. The two conduits used for power generation are 4 by 4 ft. each whereas the raw water supply conduit is 2 by 4 ft. in cross section.

The conduits discharge near the pumping station into two 54-in. steel penstocks for turbine connections and one 36-in. steel suction line to the raw water pumps. A 24-ft. diameter steel surge tank, its top level reaching an elevation of 65 ft., is connected to one of the 54-in. steel penstocks adjacent to the raw water pumping station. All lines are valved and cross connected. In normal operation, both power conduits are open; the cross connection with the 36-in. water supply line is protected against unscreened water feeding into the pumps, but is open to reverse flow for surge suppression.

Raw Water Pumping Station

The raw water pumping station is a brick and steel structure housing three 4.5-mgd. pumps and a hydraulic turbine-driven power generator. Two of the raw water pumps have dual drives and may be driven either directly, by 200-hp. squirrel-cage motors connected at one end, or, through gears, by horizontal hydraulic turbines located at the other end of the pump axis. The Francis type turbines are rated at 210 hp. with a 48-ft. head. With flashboards in place on the dam, and a tidal elevation of 0, a head of 55 ft., less the friction losses in the conduits, is available to drive the turbines. The third raw water pump is motor-driven only. Space is available in the station for three additional motor-driven units.

The vertical electric generator, driven by a vertical Francis turbine, has a 350-kw. capacity at its rated head. Sufficient stream flow is available for a good part of each year to operate all turbine-driven units. Over longer periods, both, and for still longer periods, one of the raw water pumps can be driven by water power.

The generator forms an alternate source of power for the two wound-rotor type, motor-driven, high-service pumps located in the high-service station. Not only does the power avail-

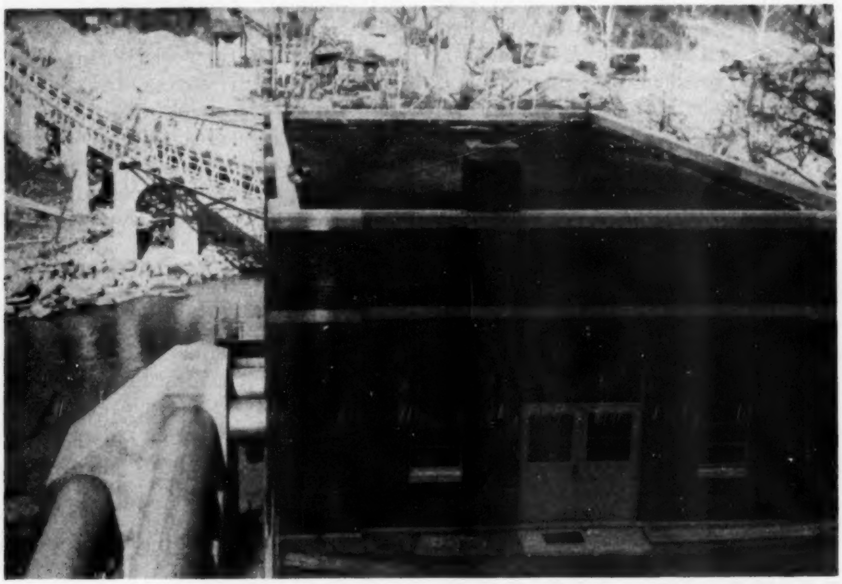

Fig. 1. Raw Water Pumping Station

The raw water pumping station is a brick and steel structure housing three 4.5-mgd. raw water pumps and a hydraulic turbine-driven power generator. A 30-in. steel and prestressed concrete discharge main, extending approximately 2,500 ft. from the station, conveys the raw water to the purification plant. A steel bridge and trestle carry the pipe across Occoquan Creek and up a steep ravine to the plant.

able from stream flow reduce pumping costs, but sufficient standby power service can be furnished through hydraulic turbines to supply 9 mgd. through the operation of two raw-water and two high-service pumps and to provide light and other station needs.

carry the pipe across Occoquan Creek and up a steep ravine to the treatment plant. Space is provided on the bridge and trestle for an additional main; a connection is also provided for the possible addition of a pipe in the stream bed.

Fig. 2. Interior of Raw Water Pumping Station

The raw water pumping station houses three raw water pumps and a hydraulic turbine-driven power generator. Two of the raw water pumps have dual drives and may be driven either directly, by 200-hp. squirrel-cage motors connected at one end, or, through gears, by horizontal hydraulic turbines located at the other end of the pump axis. The third raw water pump is motor-driven only. Space is also available for three additional motor-driven units. A vertical electric generator, driven by a vertical Francis turbine, forms an alternate source of power for the two wound-rotor type, motor-driven, high-service pumps in the high-service station.

Raw Water Transmission Main

From the raw water pumping station, a 30-in. steel and prestressed concrete discharge main conveys the raw water approximately 2,500 ft. to the purification plant, which is on a hill, at an approximate flow-line elevation of 245 ft. A steel bridge and trestle

Figure 1 is an exterior view of the raw water pumping station and the discharge main; Fig. 2 shows the interior of the station.

Treatment Works

The plant does not employ any unusual treatment process. Raw wa-

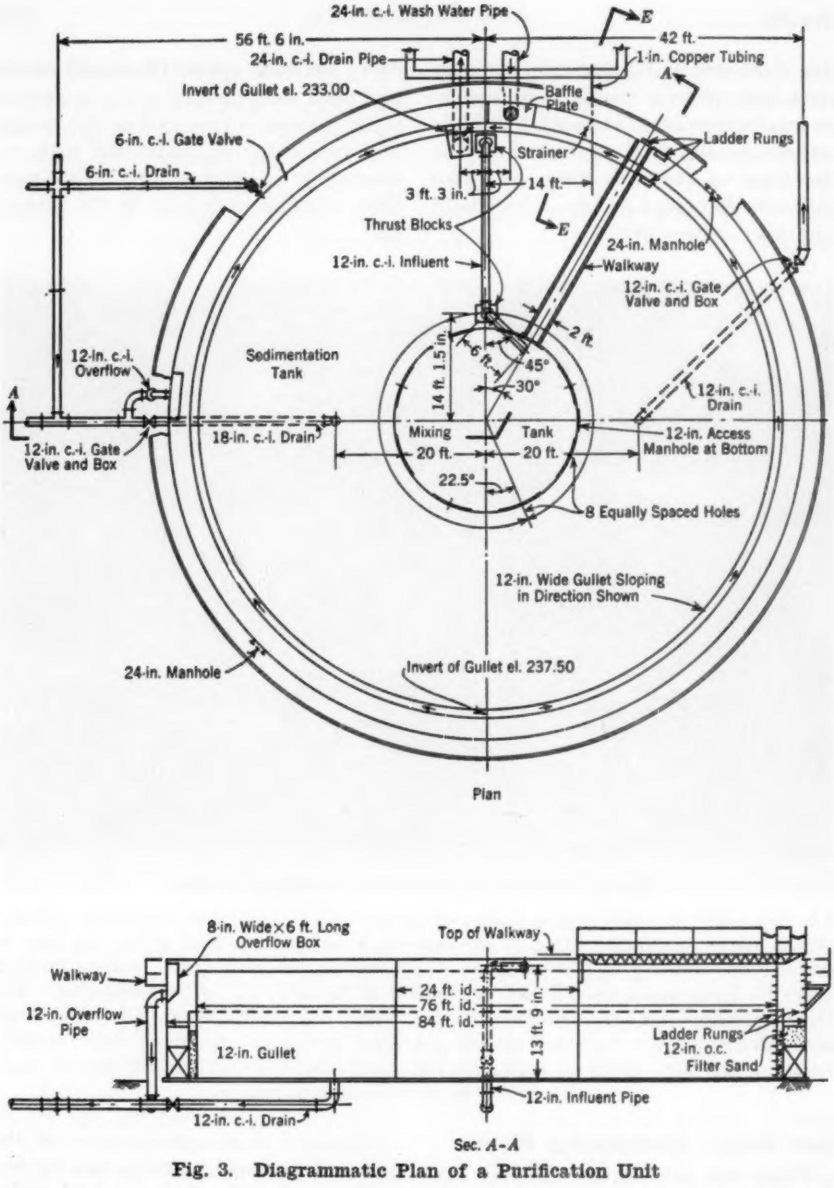

Fig. 3. Diagrammatic Plan of a Purification Unit

The basic plan of the Occoquan treatment plant incorporates in each of four individual purification units complete facilities for mixing, flocculation, settling and filtration. The units are constructed in the open as round, steel tanks. In the center is a circular mixing and flocculating compartment surrounded annularly by the settling compartment; the filter comprises the outside annular space with a drain gullet separating it from the settling basin. Section E–E is shown in Fig. 4.

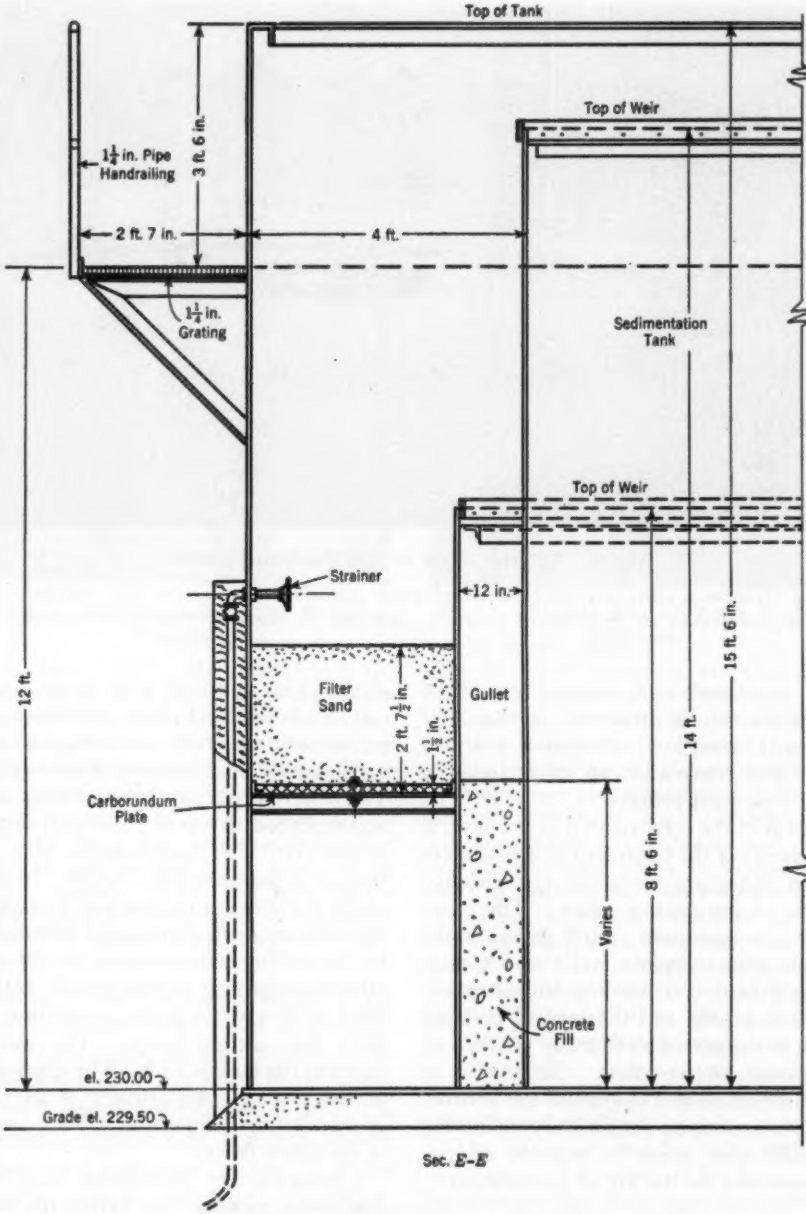

Fig. 4. Cross Section of Filter Unit

This view of the outer portion of the purification unit corresponds to Sec. E–E of the plan in Fig. 3.

Fig. 5. Exterior View of the Purification Units

The Occoquan units are constructed of steel, but similar units can also be built of plain, reinforced or prestressed concrete, and can be earth embanked or covered if desired. Depth of water in each tank is 15 ft.

ter is treated with alum, lime, carbon and chlorine as required; mixing, settling, filtering, pH correction and pre- and postchlorination are all included in the treatment process.

It is in the construction of the several elements of the treatment unit that there is a departure from the conventional type of purification plant. There are four independent purification units, each with complete facilities for mixing, flocculation, settling and filtration. Space, piping and the control building are so organized as to make possible an ultimate twelve units. Economies of construction and operation are secured by this design; preliminary operating results also seem to indicate an improvement in the art of purification.

Purification Units

Although the four purification units at the Occoquan plant are constructed in the open as round steel tanks, they can also be built, of plain, reinforced or prestressed concrete, and they can be earth embanked or covered if necessary. The different purification processes are accomplished in annular compartments of each unit. A diagrammatic plan of the unit is shown in Fig. 3 and 4. In the center is a circular mixing and flocculating compartment, surrounded annularly by the settling compartment; in still another annular ring, on the outside, is the filter with a drain gullet separating it from the settling basin. The water depth in the tank is 15 ft. The diameter of the mixing compartment is 24 ft.; of the settling compartment, 76 ft.; and of the filter, 84 ft.

Chemicals are introduced into the raw water pipeline just before the water enters the central compartment of the purification unit. A quick mix is secured in the entrance line and the

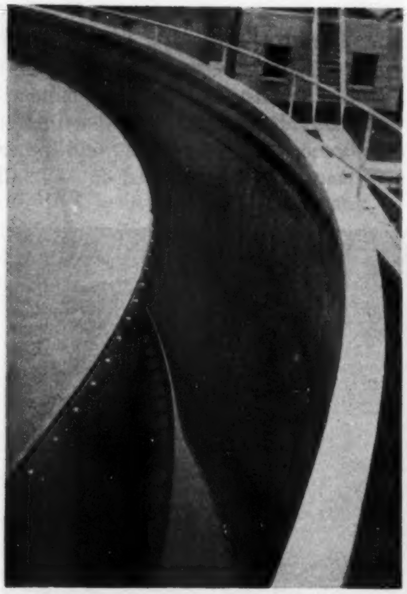

Fig. 6. Outside Rim of the Filtering Compartment

The filter, circling the periphery of the tank, is 3 ft. wide. The drain gullet, located between the filter and the settling compartments, is filled with concrete and slopes down from the back of the filter to the drain outlet in front. The filter medium consists of 30 in. of sand resting directly on a filter bottom composed of porous carborundum plates supported by steel channels. Below the filter bottom is an annular filtered water compartment which is 4 ft. deep.

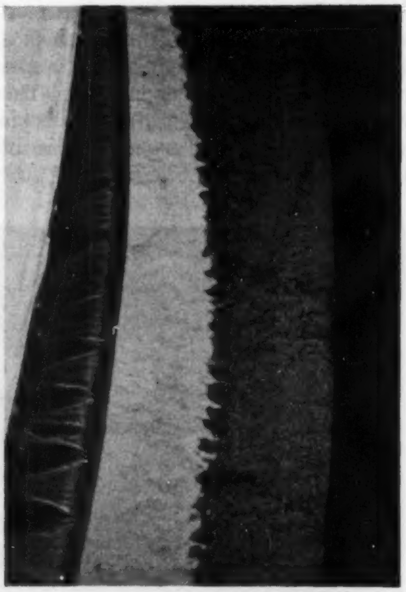

Fig. 7. Outside Rim of Filter During Backwash

The hydraulic valves in the Occoquan plant are controlled pneumatically and washing of the filters is accomplished either automatically or manually from a central control board. Under automatic operation, an electropneumatic program control instrument will continue the washing operation by opening and closing the necessary valves throughout the cycle of washing and returning the filter to normal operation. Included in the program is a selective two-stage washing period with time elements and rates of wash controllable at the central control board. A controller in the wash line serves to regulate the wash rate.

mixing is continued more slowly by introducing the treated water tangentially at the top of the mixing chamber. Mechanical mixing can easily be provided. The flocculated water passes on to the settling compartment through baffled, horizontal slots near the bottom of the mixing compartment ring. The movement of water through the settling basin is upward and outward, its velocity decreasing as it enters the filtering compartment over the top of the second annular ring.

The filter, circling the periphery of the tank, is 3 ft. wide. The drain gullet between the filter and the settling compartments is 1 ft. wide; it is filled with concrete which slopes from the back of the filter to the drain outlet in

front. The maximum movement of wash water is 3 ft. Although surface wash is not used in this plant, it can be installed simply and economically. The exterior of the purification units is shown in Fig. 5. The outside rim of the filter is shown in Fig. 6, with Fig. 7 showing its appearance during backwash.

Fig. 8. Panel Control Board

The operation of the filters is controlled either automatically or manually from a central control board. Pneumatic filter rate setters permit the operator to change filter rates for individual filters without visiting the valve houses. In fact, the entire filtering operation, including variations in filtration and wash rates, can be controlled from the board. Head loss and flow rate recorders, as well as the customary elevation, venturi meter and pressure gages, are provided on the control board.

The filter medium consists of 30 in. of sand ranging in size from 0.45 to 0.50 mm., with a uniformity coefficient of 1.6. The sand rests directly on the filter bottom, which is composed of porous carborundum plates supported by steel channels. Below the filter bottom is an annular filtered water compartment, 4 ft. deep. Necessary piping connections, consisting of influent, effluent, wash and drain connections, with hydraulic valves, controllers, and other appurtenances, are housed in a small building located between the two filters over the main lines. These are constructed of reinforced concrete pipe and are completely buried. An exterior rewash connection on each unit discharges into an open sump.

The operation of the filters is conducted in the usual manner except that

in the Occoquan plant the hydraulic valves are controlled pneumatically and washing is accomplished either automatically or manually from a central control board, shown in Fig. 8. When loss of head in a filter reaches a certain predetermined limit (normally from 8 to 10 ft.), an alarm bell rings and a light goes on to indicate the need for washing. Automatic operation is instituted by the pressing of a button, and an electropneumatic program control instrument opens and closes the necessary valves throughout the cycle of washing and returning the filter to its normal operation. Included in this program is a selective two-stage washing period, the time elements and wash rates of which may be varied at the central control board. Push button control is also provided at each purification unit to permit prolonging the wash period. Present operations are based on a low wash rate of approximately 9 in. rise per minute for 3 minutes to break up the filter sand slowly; for scouring action, this is followed by an 18 to 20 in. rise for from 5 to 6 minutes. A controller in the wash line serves to regulate the wash rate.

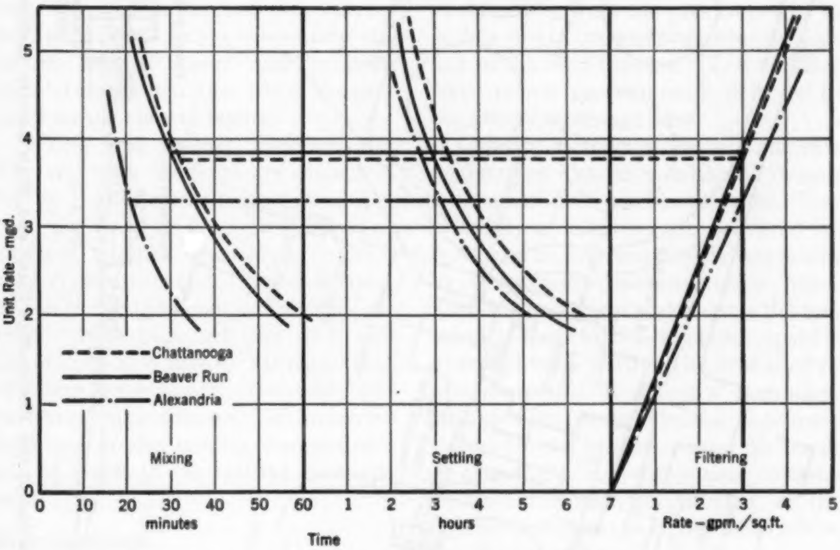

Fig. 9. Mixing, Settling, and Filtration Rates

Mixing and settling detentions for filter loadings at the Chattanooga, Beaver Run and Alexandria plants are compared. At a normal filter rate of 2 gpm. per sq. ft. of filter area, approximately 30 minutes' detention in the mixing compartment and 4.65 hours in the settling compartment are provided in the Alexandria plant. It is expected that each unit can operate at a rate of 3.0 mgd. This will give satisfactory treatment and provide approximately 23 minutes' detention in the mixing compartment and 3.5 hours in the settling compartment.

Pneumatic filter rate setters are also provided on the control board, permit-

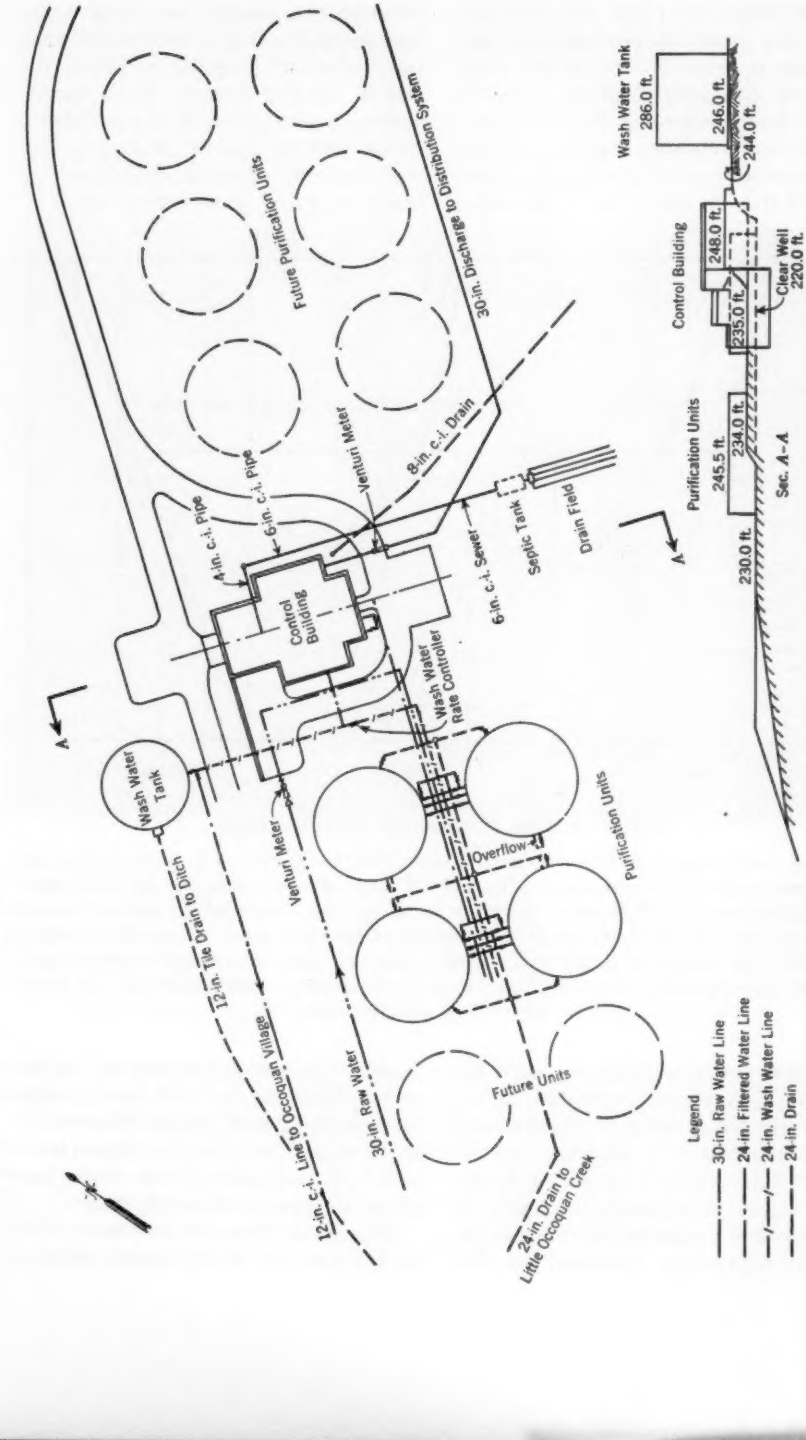

Fig. 10. Plan and Elevation of the Purification Plant and High Service Station

ting the operator to change filter rates for individual filters without visiting the valve houses. In fact, the entire filtering operation, with whatever variations are desired, can be controlled from the board. Occasional visits to the filters, particularly during washing, are of course desirable, but, with automatic operation, they are not normally necessary. Head loss and flow rate recorders, as well as the customary elevation, venturi meter and pressure gages required in a filter plant, are provided on the control board.

Mixing and settling detentions for different filter loadings are shown in Fig. 9. At a normal filter rate of 2 gpm. per sq.ft. of filter area, approximately 30 minutes' detention in the mixing compartment and 4 hours 42 minutes in the settling compartment is provided. It is expected that each unit can operate at a rate of 3.0 mgd., thus affording satisfactory treatment and providing approximately 23 minutes' detention in the mixing compartment and 3½ hours in the settling compartment.

Control House

As previously noted, the control board (Fig. 8) for the operation of all filters is located in a central building. Space is also provided here for chemical feed equipment, chemical storage, chlorine cylinder scale and chlorination rooms, high service pumping equipment, laboratory, office and service rooms of various descriptions. Figure 10 is a general plan and elevation of the purification plant and high service station.

The chemical feed equipment consists of two alum solution machines and loading hoppers, two lime machines, a lime saturator tank and storage space which will hold more than four carloads of chemicals. A carbon feed machine and storage space are located in a separate room.

Chemicals are received in bags, unloaded on wooden pallets and moved by a small gasoline-driven fork truck. They are stored on the pallets, in stacks 4 ft. high, with two pallets in each tier. The chemicals are handled only twice: in unloading from the cars or trucks to pallets and in transferring from the pallets to the feed hoppers. The building construction permits truck delivery to the chemical storage floor.

Chlorine cylinder scales and chlorine feeders are located in adjacent rooms, with scale dials visible in both. Ton cylinders of chlorine are delivered by truck and transferred to weighing scales by a manually operated chain hoist. Two such platform scales serve the two solution-feed chlorinating units; space is provided for a third. The unit used in prechlorination is operated manually; that used for postchlorination is proportioned to the venturi meter discharge measurement. A continuous chlorine residual recorder is provided in the chlorination room to record residuals in the filtered water.

The high-service pumping equipment comprises three 4.5-mgd. centrifugal pumping units operated by 200-hp. motors. Two units are run by wound-rotor type motors operated either by outside power or by power generated at the raw-water pumping station. The third unit is driven by a squirrel cage motor. The switchgear is arranged to keep the two sources of power separate, but it is possible to operate the wound-rotor units on generated power while the third unit is operating on purchased power. Starter and control equipment is housed in enclosed cabinets aligned with the filter control board. Manually operated

cranes have been provided in the pump rooms of both the raw water and high service stations to facilitate the moving of equipment.

A small service room holds a priming pump and, for use in the event of failure of other sources of power, a small gasoline-driven high pressure pump to operate hydraulic valves and fill other station needs, and a small gasoline-driven lighting generator.

The laboratory is fully equipped for all the usual chemical and bacteriological testing. A small office is provided, as well as toilets, a wash room and a heater room. In the rear of the building, beneath the chemical storage room, is storage space for trucks and work equipment of various sorts.

The control building (Fig. 11) is pleasing in appearance and soundly built. Its exterior brick is buff colored with precast concrete trim, aluminum windows, stainless steel downspouts and an aluminum canopy and entrance door. All of the rooms except the storage and service rooms are finished in buff colored, glazed wall tile, and are equipped with acoustic ceilings and red quarry tile floors.

Beneath the main building is a filtered water basin with a capacity of 410,000 gal. Additional storage in the purification units totals 90,000 gal., but is usable only when the individual filters are not in operation. Piping connections in the basin as well as wash water tank and pumping arrangements are designed for a definite future use. The 1-mil.gal. wash water tank provided for in the original construction is oversize and so located as ultimately to serve also as a storage tank on the plant end of a future low level main serving the area along the Potomac River and the main service area in Alexandria. To further this purpose, flexibility of pumping and piping provisions has been provided.

The filtered water normally flows directly from the filters into the clear well below the control house. The clear well can be bypassed, however, through a pipeline which carries the filtered water directly to the high lift pumps. Wash water pumps taking suction from the clear well normally fill the wash water tank through a branch of the same discharge header which provides the suction for the high lift pumps. Hydraulically operated valves, operated from the filter control board, permit

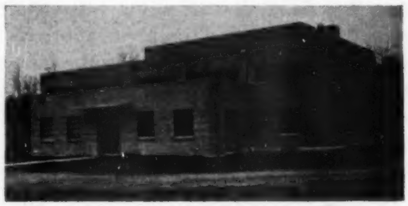

Fig. 11. Exterior View of the Control Building

The control building is pleasing in appearance and soundly built. The exterior brick is buff colored with precast concrete trim, aluminum windows, stainless steel downspouts and an aluminum canopy and entrance door.

the high lift pumps to take suction from the clear well, from the filters directly, or from the discharge header of the wash water pumps connected to the tank. The storage and head now provided by the tank and the booster service which will be provided by the wash water pumps can be utilized to increase high service discharge rates and pressures.

At present, the wash water pumps are only large enough to furnish wash water. In the future, they will be replaced by pumps with a capacity of 25

to 30 mgd. designed to serve three possible uses: (1) provide wash water; (2) provide a low service supply to Alexandria and the intervening low area; and (3) provided a booster for the high service pumps when demands in that service require it.

Operating Results

It was believed that certain benefits would be derived from this new type of plant in addition to the economies of construction. Preliminary operating experiences seem to indicate that these benefits will be achieved.

It was believed that the conditioning of the water for filtration would be improved by as little movement and agitation as possible after settling. In the conventional filtration plant, the settled water is considerably agitated as it travels through pipelines or valved openings to the filters. The smaller and lighter floc which remains after settling, and which it is desirable to carry intact to the filters, is broken up and dissipated by such agitation. In the Occoquan filters, there is no such disturbance of floc. To prevent any turbulence or undue increase in velocity as the settled water passes to the filter, the filter compartment is filled to the normal flow line after washing.

It follows that there is a negligible loss of head from the time the treated water enters the purification unit until it reaches the filter sand. In many plants, the loss of head through piping and valves between the mixing and settling basins and between the settling basins and filters is substantial.

Another important difference in these units is the depth of the water maintained over the filter sand. The conventional filter maintains a depth of 3 to 4 ft. whereas the depth in these units is approximately 8 ft. There is no negative head developed in the filter sand or below for filter losses of up to 8 ft. To filter with such a loss in a conventional unit would require a negative head in the underdrain system. It is possible that a somewhat different and improved filtering action will result from eliminating all operations with negative head.

Tests have indicated that the loss of head in the filter when washing at a 24-in. rise is only 33 in., with 3 in. of this occurring in the porous plate. The character of the washing action in the Occoquan filters is also different, so that a 20-in. wash rise seems to be effective in securing a good scouring action on the sand.

Average filter runs vary between 40 and 65 hours when washing at head losses of 8 ft.; the amount of wash water used is between 1.5 and 2.5 per cent.

Whenever one filter is out of operation, the corresponding mixing and settling capacity is also idle, so that a more uniform operating result is achieved. It is possible to expand the entire plant simply and economically by adding additional units when required.

Occoquan Creek may be described as a "flashy" stream characterized by quick changes in water quality. Color removal is always a problem and, at times of heavy rains, turbidity changes are rapid and large.

Table 1 compares the results of purification operations during the months of December 1949 and 1950 and January 1950 and 1951 at both the old and new plants. Turbidity and color at both plants were negligible following filtration. Although the new plant has been in operation for only a short time and receives a somewhat more highly colored raw water, with more variable

TABLE 1

Comparison of Treatment at the Cameron Run and Occoquan Plants

Description	Cameron Run Dec. 1949	Occoquan Dec. 1950	Cameron Run Jan. 1950	Occoquan Jan. 1951
Treated water—*mil.gal.*	191.45	199.64	193.84	200.64
Range—*mgd.*	5.14–6.67	5.26–6.94	5.40–6.56	6.09–6.81
Raw water avg. turbidity—*ppm.*	23	69	16	29
Range—*ppm.*	7–200	15–600	7–100	16–50
Raw water avg. color—*ppm.*	19	38	19	33
Range—*ppm.*	T–35	25–70	T–35	25–55
Raw water avg. alkalinity, M.O.—*ppm.*	19	20	19	24
Filtered—*ppm*	25	24	24	29
Raw water range—*ppm.*	14–21	12–24	16–20	22–26
Filtered range—*ppm.*	23–27	18–29	23–26	22–32
Avg. pH—Raw	7.0	7.0	7.0	7.1
Filtered	8.7	8.2	8.6	8.4
Range raw	6.9–7.1	6.6–7.1	6.9–7.1	7.0–7.3
Range filtered	8.5–8.9	7.4–8.7	8.5–8.8	7.9–8.7
Water temperature, avg.—*°F.*	41.1	38.2	45.5	37.3
Range	36–49	34–44	38–53	35–41
Lime used—lb.	17,350	21,050	16,700	25,890
Cost	$156.15	$ 210.50	$150.30	$258.90
Cost per mil.gal.	$ 1.82	$ 1.05	$ 0.77	$ 1.29
Alum used—lb.	19,950	33,700	20,300	25,750
Cost	$379.05	$ 674.00	$388.10	$515.00
Cost per mil.gal.	$ 1.98	$ 3.38	$ 2.00	$ 2.56
Carbon used—lb.	1,140	560	1,090	0
Cost	$ 68.40	$ 33.60	$ 65.40	0
Cost per mil.gal.	$ 0.36	$ 0.17	$ 0.34	0
Ammonium Sulfate—lb.	603.3	0	509.4	0
Cost	$ 22.32	0	$ 18.85	0
Cost per mil.gal.	$ 0.12	0	$ 0.10	0
Chlorine (pre-)—lb.	972.5	716	970	476
Cost	$106.98	$ 57.28	$105.75	42.84
Cost per mil.gal.	$ 0.56	$ 0.29	$ 0.55	$ 0.21
Chlorine (post-)—lb.	1206.5	1230	1018	955
Cost	$132.72	$ 98.40	$110.98	$ 85.95
Cost per mil.gal.	$ 0.69	$ 0.49	$ 0.57	$ 0.43
Total chemical cost	$865.62	$1,073.78	$839.38	$902.69
Cost per mil.gal.	$ 4.52	$ 5.38	$ 4.33	$ 4.49

turbidity than the old, preliminary results compare favorably with those at the old plant. Bacteriological results were uniformly good at both plants.

The operating force of twelve consists of four shift men at the raw water pumping station and four at the purification plant, a chief engineer, a chemist, a maintenance man and a laborer. Both the chief engineer and the maintenance man have certain other duties in addition to their work at the Occoquan plant.

Construction Cost

The construction of the new Occoquan plant was carried on by force account under the supervision of the American Water Works Service Co. Transmission mains were laid by contract, but all materials were purchased by the service company. The cost of

the different parts of the project, excluding the cost of the land, engineering and interest during construction, is shown in Table 2. Estimates of the cost, at 1950 levels, of plants of various sizes are given in Table 3. Assuming

TABLE 2

Cost of Construction—Occoquan Project

Item	Cost
Dam and intake	$ 174,234
Raw water conduit	183,122
Raw water pumping station	84,153
Raw water pumping equipment	108,679
Roads to raw water station	18,927
Power line	8,914
Raw water main and bridge	104,991
SUBTOTAL	683,020
Purification units, piping and controls	330,947
Control house and high service station	149,892
Valve houses	13,060
Clear water reservoir	41,193
Wash water standpipe	43,895
High service pumping equipment	67,399
Chemical treatment equipment and furniture	17,898
Roads, grading and planting	28,415*
SUBTOTAL	692,699*
Transmission mains	
30-in. (47,000 ft.)	733,562
24-in. (30,700 ft.)	340,965
20-in. (6,500 ft.)	82,268
SUBTOTAL (84,200 ft.)	1,156,795
TOTAL COST	$2,532,514*

* Approximately $7,000 remains to be spent.

a 3-mgd. unit capacity, based on a filtration rate of 2.7 gpm. per sq.ft., the constructon of four units, including high lift pumping equipment adequate for 12 mgd., would have totaled $705,000, or $58,700 per mgd. Expanded to include twelve units, the estimated cost would have been $1,093,000, or $30,400 per mgd. of capacity.

A conventional filter plant of 5 mgd. capacity (with 10 mgd. of settling capacity) was constructed at the same time, and under the same supervision, in Granite City, Ill. Although simply constructed, and with the same plant elements, but without Occoquan's provisions for expansion, the cost amounted to over $100,000 per mgd. of capacity.

In these times of rapidly soaring costs, a private utility must seek every means at its disposal to effect economies. The level of prices vividly accents the fact that substantial savings can be effected in the construction of the Occoquan-type plant over the conventional filter plant. Further economies may be achieved by providing flocculators or similar mechanical equipment to reduce settling time.

Acknowledgments

The Occoquan project was designed and constructed under the supervision of the American Water Works Service Co., an operating affiliate of the American Water Works Co. and the Northeastern Water Co. The Alexandria Water Co., incorporated in 1851, is a subsidiary of the American Water Works Co. Howard C. Richards is the local manager of the company.

The author supervised the general design and construction of the plant and originated the design of the purification units. The design was supervised by H. J. Carlock, Chief Design Engr., assisted by C. E. Trowbridge, Chief San. Engr., and D. F. Bixler, Mech. Engr., on the chemical and mechanical design and equipment respectively.

The construction of the plant, by force account, was carried out under the general supervision of G. A. Wood-

TABLE 3

Estimated Cost of Occoquan Purification Plant and High Service Station

Description	Number of 3-mgd. Units				
	4	6	8	10	12
Purification Units, Piping and Controls	$331,000	$410,000	$500,000	$570,000	$650,000
Control House and High Service Station	150,000	150,000	150,000	150,000	150,000
Valve Houses	13,000	20,000	27,000	34,000	41,000
Clear Water Basin and Wash Water Tank	85,000	85,000	85,000	85,000	85,000
High Service Pumping Equipment	72,000	78,000	85,000	92,000	99,000
Chemical Treatment Plant	18,000	20,000	22,000	24,000	26,000
Roads, Grading and Planting	36,000	36,000	38,000	40,000	42,000
TOTAL COST	$705,000	$799,000	$907,000	$995,000	$1,093,000
COST PER MGD. OF CAPACITY	$ 58,700	$ 44,400	$ 37,800	$ 33,300	$ 30,400

house, Chief Construction Engr., with E. F. Meyer, Construction Engr., directly in charge.

Under the local manager, N. W. Masker, Chief Engr., and A. W. Lamond, Chemist, are in charge of operation of the plant.

The filter equipment and controls, including the remote control and automatic filter and washing mechanism, were engineered and built by Builders-Providence, Inc. Ingersoll-Rand and the General Electric Co. furnished the pumping and electrical equipment; James Leffel & Co., the water turbines. Hammond Iron Works furnished and erected the steel purification units, wash water tank and surge tank. The Carborundum Co. furnished the porous plate filter bottoms.

Transmission mains were laid, under contract, by Henry Alward & Co., Nance & Vivadelli, and the A. Stanley Mundy Co. Prestressed concrete pipe was furnished by the Lock Joint Pipe Co.

Construction started in June 1949 and was virtually complete in September 1950. Preliminary operation began in October; the plant has been in continuous operation since December 1, 1950.

The photographs used to illustrate this paper were made by Ralph Tyler of the American Water Works Service Co., Philadelphia, Pa.

Officers and directors of the subsidiary and parent companies deserve full credit for approving and supporting the project, particularly those elements of the purification plant which depart from the conventional. It is only by such successful experimentation that progress becomes possible.

The Relationship of Water Works to General City Administration

By John H. Huss

A paper presented on October 25, 1950, at the Michigan Section Meeting, Detroit, Mich., by John H. Huss, Director, Michigan Municipal League, Ann Arbor, Mich.

IT may seem obvious that a safe and adequate water supply has had a marked influence on the growth and development of America's cities and villages. The truth of this statement is clearly demonstrated by recent developments in the community of Sanford, Mich.

Sanford, an unincorporated community of approximately 500 people, located about ten miles west of Midland, is now experiencing a decline in population because of an inadequate water supply. Its people are dependent upon simple dug wells which do not produce enough wholesome water to meet their needs. In an effort to supply members of the community with a good water supply, civic leaders in Sanford are planning to incorporate as a home rule village as the only means by which they can create a framework within which they can meet this problem effectively.

Similar problems have arisen elsewhere and have been resolved in a like manner. Their handling suggests how vital is the link between the water utility and the municipality and how necessary is the establishment of an effective and sound working relationship between the elected representatives of the people and those technicians and administrators concerned with supplying wholesome and abundant water. The creation and sound operation of a water utility is not an end in itself, but a means to promote and safeguard the general health and welfare of the citizens of a community.

Without the type of water supply that water works officials are today making available, urban living would be impossible. In general, the interdependence of individuals varies directly with the number of people living within a given area. As the population of a city increases, the need for proper safeguards for the public health are augmented almost with each individual addition to the community. A sound public health program invariably gives top priority to a sanitary and abundant water supply.

Without the necessary water supply, the amazing technological progress made in the present century would not have been possible. Technological progress is not possible without industrialization; industrialization implies urbanization; and urbanization is impossible without a water supply which meets the multifold needs of the community.

Accompanying the marked growth of municipal services has been a growing awareness on the part of the public that government is equipped to do a job and to do it well. No longer can

it be said that "government is sure to be inefficient." The commendable achievements of municipal water utilities have helped to explode the myth of governmental incompetence. It must be remembered that as the level of efficiency in providing municipal services increases, the extension of municipal activities will also increase. The role of water works officials in fostering the growth of municipal services cannot be overemphasized. In a very real sense, they have made a genuine contribution both to the growth of municipal services and to the proof that government can do an efficient, businesslike job.

Many services now available in the municipalities of this country have only been rendered for a relatively short period of time. Unquestionably, it is necessary to exert every effort to find ways in which a given service can be improved. There will undoubtedly be realignments and readjustments in municipal organization and operation which will result from the experience gained in current operation. Activities now performed by municipalities may be omitted or dropped; others may be taken up by private business or the effects may be reversed. Regardless of what changes do or do not take place, it is important to bear in mind that municipalities, like states, should be thought of, in some measure, as laboratories in which may be found the best means of providing services in a democratic manner.

Only insofar as problems are approached with an open mind, intelligently and with imagination, can the water utility expect, in the future, to provide the most efficient municipal service at the lowest possible cost. This is a matter with which water utility people are vitally concerned in their day-to-day and month-to-month operations. It is of great concern to most elected representatives of cities and villages and to all conscientious administrators regardless of their particular fields of activity.

Municipal Water Works

There are several reasons why the water utility should be an integral part of the general municipal government. The close relationship which already exists between the water utility and the municipal government has been suggested as one reason. The importance of water to the growth and development of the country's municipalities, has also been emphasized. In addition, municipal governments provide a framework conducive to the growth and improvement of water utilities Without planning, zoning, plumbing regulation and building codes, for example, it would be impossible for the average water works to operate at its present high level of efficiency. This mutual dependence suggests that integration of the water works into the framework of the general municipal government would not be an unnatural arrangement and to the author's mind the advisability of such a step is apparent.

If the interdependence of the water department and the rest of the city government can be clearly established, the only remaining argument for "independent status of the water works" would seem to be the necessity for keeping "politics" out of water department operations. Both propositions will bear examination.

One of the closest relationships existing between the water department and another municipal service is that between the water department and the municipal fire department. Without a

water works system designed, constructed and operated in such a manner as to provide a supply of water adequate to community fire protection, a fire department offers only nominal protection. The public water supply is the most important of a number of factors determining fire insurance rates. It is absolutely necessary for the heads of the water works and fire departments to understand each other's departmental problems and limitations. A spirit of cooperation must prevail between these two departments in every community.

Cooperation

Cooperation between the public works department and the water works department is also important. What would happen, for example, were streets and sewers to be flushed during hours of peak domestic use? The answer clearly indicates that cooperation is necessary to avoid the consequences of the badly timed water usage. For a water department to be properly advised of emergencies that require special conservation practices, cooperation between departments is essential. Such cooperation is also essential in coordinating street paving and main installation programs and in any public relations program which aims to secure public support for a conservation program. Such programs are the responsibility of the elected representatives as well as the department heads.

Certainly close cooperation is vital in city planning. Suppose for a moment that the city planner recommended annexation, with utter disregard for the resulting problems that might face water officials. The point does not have to be labored.

Most readers will immediately recognize the importance of cooperation in the areas already discussed. There is one area, however, where, in the author's experience, water works people have not recognized the necessity of cooperation with the general city administration. This is in the field of salaries and wages. In the several years that the author has worked with municipal governments, in the development of classification and salary and wage plans, he has frequently found that the salaries and wages of water department employees exceeded those of other departmental employees doing work of equal difficulty and responsibility. It is not suggested that the wages of water department employees be lowered. It should be recognized, however, that the salaries and wages of employees of independent water departments are frequently set without any relationship to those of other employees in the city government. This may be directly attributable to the highly independent operation of the water departments.

Financing Water Works

The close relationship between water works administrations and the municipal governments can be seen in the financing of water operations. The rates charged are fair and just only if consideration is given to local conditions which affect both the costs of the utility and general administrative policy. There can be little question but that the rates charged for water service should be adequate to meet the cost of supplying the service (capital, operating and maintenance costs). Rates should also be adequate to cover necessary improvement and should be set high enough to enable the water department to meet any possible contingencies. In the author's opinion, the city should pay for municipal use

of water and the water utility should show as an operating expense those special services secured from the municipal government. The accounting system should, in a very real sense, reflect an independent status for the water utility even though the utility itself may not be operating completely outside the broad governmental framework.

Proper financial planning in a municipality requires that a very important segment of the total plan include water works improvements. This principle again suggests the need for the complete cooperation of the water works expert and the municipal planning group that is only possible when the water department is closely knit with other municipal departments. In Michigan, municipalities have greater freedom in financing improvements than they do in many states. An improvement can be financed by revenue bonds—by which the earnings of the utility are pledged—or general obligation bonds—by which the taxing power of the municipality itself is pledged. If the idea of financial independence is carried to its logical conclusions, revenue bonds usually offer the best method of financing improvements. If close cooperation exists between the utility and the municipal administration (because rates are invariably fixed by ordinance), and if the management of the water utility is efficient and has produced a satisfactory earning record, interest rates on revenue bonds should be comparable with those secured on general obligation bonds, even though the latter can usually be sold at a slightly lower interest rate.

The financing and financial planning of a water utility can only be conducted properly in terms of the total needs of the community. Planning and administrative policy are the proper function of elected representatives and municipal administrators; Financial plans must necessarily be drawn up in terms of total government needs, not in terms of what may be desirable in any one area. The utility should be so managed, however, as to allow its internal managerial and financial affairs to be handled with relatively little "outside" interference.

The question of diversion of utility earnings to other governmental operations is another important aspect of water utility financing. The experts, themselves, are at odds on the merits of this practice. According to a very good authority (1):

> Those who oppose the practice contend that the policy, once established, will lead to abuse, and that the financial structure of the utility will ultimately be impaired. They think it unfair to the consumer to be required to bear the added burden of the support of general government by subscribing to rates above those that would be required if no part of the earnings were diverted. In general, these objections are sound. Both those who favor some diversion of earnings and those who oppose such a policy agree that any diversion is obviously unwise which jeopardizes the ability of the utility to meet financial obligations, to operate and maintain itself satisfactorily and to provide adequate funds for future expansion.

There are conditions in some cities, however, which seem to justify some diversion of utility revenues for the support of the general city government. Small cities largely built around public institutions which do not contribute to municipal revenues find it necessary to have some means of increasing their income other than by taxing real property if the desired level of local government is to be maintained. The property tax base of such cities is usually small and, in addition, the proportion of rented prop-

erty to owner-occupied homes is apt to be large. By maintaining rate schedules for municipal utility service somewhat above those required for necessary utility purposes and diverting the excess earnings to general city funds, a portion of the cost of local government is shifted to the utility customers. Since many of these are renters who pay no property tax, home owners are thereby relieved of some of the excessive real estate taxes otherwise necessary. There is little danger of abuse of such a policy if property tax rates are maintained at high levels and the public is fully informed of the need for diverting a reasonable amount of utility earnings each year to supplement tax revenue. The reason and need for the practice should be explained and fully understood by both taxpayers and utility consumers before such a policy is put into effect.

Independent Boards

Consider the operation of the independent boards in contrast to departments with single heads. The International City Managers' Assn. (1, p. 185) does an excellent job of classifying the various types of water utility management. It points out that there are four major groups in the United States:

1. District water authorities having jurisdiction over regional districts embracing self-supporting utilities of one or more municipalities with their adjacent distributing territories.
2. Independent boards or commissions within a municipality created to administer water utilities, independent of the central municipal government.
3. Administration under a single individual such as the appointed city manager in the council-manager plan; an elected commissioner under the commission plan; or the mayor in the mayor-council plan of government.
4. A committee of the council in the mayor-council plan of government.

Much has been written about the relative advantages and disadvantages of the various types of administrative authority. As is pointed out by the I.C.M.A. text (1, p. 185): "The economics involved in a remote or difficult source of supply and the nature of the distribution system determine to a large extent the wisdom of creating regional districts."

The author recognizes that there are many who favor the independent board because they feel that it frees utility management of political interference. There are some who fear a concentration of administrative authority in a single individual such as a city manager, commissioner, or mayor. They contend that such an individual would assume the responsibilities of the detailed operation as well as the administration of the utility, would dispense with the services of a competent superintendent and would scatter the various functions of the water works such as accounting, purchasing and construction among the various city departments handling similar matters. Certainly no competent individual, whether he be city manager, commissioner or mayor, would pursue such a course unless by so doing some material benefits accrued to the utility. In many of the smaller and in some of the larger municipalities the billing and collection of accounts, purchasing of supplies, meter reading and other functions can be combined with other similar functions of the central municipal government to effect substantial savings in operating costs. For example, the use of utility meter repairmen as inspectors or parking meter repairmen might mean a lower cost of government and a better utilization of personnel. Where such economy is possible, there appears to be no

logical reason why the consolidation of functions should not be made and the saving realized.

The I.C.M.A. text also points out (1, p. 186):

Under any form of administrative authority, the water utility should be free from political interference. The legislative body under which top management in the utility operates will, in any sense, be composed of elective or appointive officials, but if the utility is to operate in a satisfactory manner, the person directly responsible for it must be free to employ and discharge the administrative and operating staff. The body of employees in either the large or small utility should be headed by an individual who has carefully been specially trained; but in any case he must be thoroughly familiar with all details of water works operation. He must be able to work with his associates in other municipal departments as well as to inspire the confidence of those under his supervision. As in other municipal functions, enlightened personnel practices are most helpful in the retention of competent and trustworthy employees in this utility.

Municipal Control

The cry, "Keep politics out of government"—or at least out of certain municipal functions—is a perennial one. Its application, however, would seem to depend on the definition of the term politics. As used above, the word would seem to indicate use of a position in government to advance individual self-interest. When an independent or semi-independent administrative board is demanded, therefore, what its advocates are in effect saying is that they want to keep the motive of personal gain out of water utility operation. This is unquestionably a desirable aim. It need not follow, however, that governmental activity and abuse of political office are necessary companions.

The term "politics," as applied to municipal governments, has come into disrepute largely because it is associated with "boss rule" of an early period of our nation's history. Happily, this state of affairs rarely exists today. The author has had unusual opportunity to observe political officers and municipal governments in action. Most of these so-called politicians are men of good character and have but one primary interest—the welfare of their community. Conversations with a number of elected representatives have convinced the author that many actually suffer financial loss in order to hold their positions. Fortunately, there still remains a strong desire on the part of these men to serve even in these poorly paid capacities. The business of formulating policy for municipal government, now that graft and corruption have been largely eliminated, is no longer a profitable financial venture.

If having a water department "in politics" means having it subject to the control of the people's elected representatives, then the author is for having it in politics.

Without the coordinating efforts and force of the politician, it would be vain to hope for any rational pattern of operation in government, either at the federal, state or local level. On the other hand, it is absolutely essential that there be someone to coordinate and integrate the efforts of the various groups in government to in some way shape up a broad, overall program which allows all of these forces to operate in the best interest of the community. True, the best interest of the community is not an easy thing to define. It is not simply a

matter of saying, "Yes, we need more water," or, "No, we need more recreation." It is trying to understand what is most essential to the welfare of the community at large. There is no absolute answer for it. Only through the democratic political processes can an approximate answer—and the best approximate answer—be reached.

It appears certain then that, regardless of the good intentions of the expert, regardless of his ability, it takes a common sense force (the political leaders, political processes and politics) to bring about efficient, democratic municipal government.

It would be naive to anticipate that any official operating under an independent water board would immediately suggest the elimination of the independent status of such a board and advocate placing all functions under a chief administrator, whether this be the mayor, the city manager or a commissioner. The author is fully cognizant of the background for the creation of an independent system. It is hoped, however, that the possibilities inherent in closer integration of the water works department with the general city administration will be recognized and that so-called local "political" conditions will not be used as an argument against such closer integration.

Conclusions

In conclusion, the author suggests:

1. That consideration be given to closer integration of the water utility with general municipal government; that appointment of a water works superintendent selected by the chief administrator for an indefinite tenure be considered; that this position be considered for civil service status.

2. That certain water works functions be consolidated with similar functions of other departments in small municipalities.

3. That salary and wage scales be established commensurate with those paid in other departments of the municipal government.

4. That a rate structure be established which will provide sufficient funds to pay capital costs, departmental operating costs, maintenance, repairs and replacements.

Only under special circumstances would the author subscribe to the theory that the water utility should finance other municipal activities.

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Discussion

By Louis E. Ayres

Ayres, Lewis, Norris & May, Ann Arbor, Mich.

One is pleased to be told that "a safe and adequate water supply has had a marked influence on the growth and development of America's cities and villages" and that "without the type of water that water works officials are today making available, urban living would be impossible."

It is also pleasant to be told that the achievements of municipal water utilities have helped to dispel the popular opinion that government is sure to be inefficient and to prove that "government can do an efficient, businesslike job." Did the municipal government

make the water works efficient, or did the efficiency of the water works help the whole city administration appear to be more efficient?

One may not differ with the author's statement that "close relationships exist between the water department and the rest of the city government." He refers to the "importance of water to the municipal fire department," to the importance of "cooperation between the public works department and the water works" and to the interest of the water works in "planning, zoning and the regulation of plumbing and building codes." One is interested to read that the author has "frequently found that the salaries and wages of water department employees exceeded those of other departmental employees doing work of equal difficulty and responsibility." He is careful not to suggest that the wages of water department "be lowered," but the inference is that water department wages may be used as an argument for higher wages in other departments.

In all of these matters the author suggests the desirability of *cooperation*—a word appearing time after time. It is interesting to note the later substitution of the word "integration" for "cooperation" when the author suggests, "that consideration be given to closer *intergration* of the water utility with general municipal government." He is cautious, however, when he says: "It would be naive to anticipate that any official operating under an independent water board would immediately suggest the elimination of the independent status of such a board and advocate placing all functions under a chief administrator, whether this be the mayor, the city manager or a commissioner. The author is fully cognizant of the background for the creation of an independent system . . . [and, as stated above, of] the commendable achievements of municipal water utilities. It is hoped, however, that the possibilities inherent in closer *integration* of the water works department with the general city administration will be recognized. . . ."

The author's meaning of integration is clear. His recommendation is that all independent or partially independent boards be abandoned and that the water utility be managed by a "superintendent selected by the chief administrator," that is, "the mayor, the city manager or a commissioner."

The writer submits that the author's recommendations are unacceptable. In general they would lead the water works of the nation more deeply into a morass of inadequate service, inequitable rates and the use and abuse of the water utility for the benefit of politicians and special groups.

The principal weakness in water works management throughout the country, but particularly in the larger cities, is that so many systems cannot independently control their income, their rate structure or their plans for development and extension. This is a serious deficiency in public administration.

For example, the recent water shortage in New York City was not due to a lack of available water, but to a surplus of politics. If the water works management in New York had possessed the "arbitrary power" which the author fears in an independent water board, a water shortage would never have occurred. The trouble was finances, not engineering. New York, like many cities, turns over all excess revenue above expenses to the general fund; when money is needed for improvements it must be obtained out of budget appropriations. In a recent

tabulation (1) covering 462 cities, it was found that approximately 37 per cent contributed varying amounts to the general fund; an equal number gave free service. Depreciation allowances varied widely. In many cities the water utilities paid no taxes but did not receive compensation for fire protection.

Study of the rate structures reveals an inequitable distribution of costs among different classes of users. It is not too difficult to find examples of too low a charge to the domestic consumer in communities where the governing body is dominated by those who won elections by promises of lower utility rates, or of too low a charge to large consumers in municipalities where the governing body is dominated by shortsighted manufacturers or industrialists. Rates should not be the subject of political manipulation to gain votes. They should be determined by technicians, exercising what the author fears is "arbitrary power," to achieve adequacy of income and equity in its distribution.

In the best interests of the public, water utilities should be under the control of strongly constituted local boards. An alternative, which is never likely to be generally accepted, is control by the state. Some city officials speaking as individuals and through state municipal leagues oppose state control. They look upon it as a further unnecessary interference with the right of cities to manage their own affairs. Where state control is effective, however, as in Wisconsin, a uniformity in rates, fire protection charges, financial and fiscal matters prevails.

The functions of any municipality may be classified into at least three categories: governmental, proprietary and educational—the last requiring no discussion in this context.

Governmental functions are many and varied. They cover those matters that are intimately related to the lives of the citizens and must be solved, in a democratic society, by the peoples' representatives. Their solutions are not found in rule books, as they are dependent on local conditions and the desires of the citizenry. Finding these solutions, and operating the government in a satisfactory and equitable manner, particularly in large cities, should be a full-time job for any council or commission under the direction of a mayor or city manager.

Proprietary functions are those connected with the financing, construction, operation, maintenance and extension of utilities. The problems involved are business problems. The rules of conduct can be set down (a job now being undertaken by the A.W.W.A.). There should be no preferences shown to individuals or groups and no modification of the rules for the benefit of politicians. The water utility should stand on its own feet, pay all of its bills and receive all proper income.

There is an old saying that "the proof of the pudding is in the chewing of the string." *A review of available data indicates that the efficiency of water works management, plant adequacy, equity in rates and public satisfaction are, in general, proportional to the independence of the management.* Any proposal that tends to reduce or destroy this independence is a step backward in the struggle to strengthen and improve one of the vital services to community living.

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Water Works Accounting Practices

By Elmer F. Carter

A paper presented on September 29, 1950, at the Rocky Mountain Section Meeting, Santa Fe, N.M., by Elmer F. Carter, Chief of Operations, Public Service Commission, Public Utility Div., Santa Fe, N.M.

ACCOUNTING, as Webster defines it, is: "The art or system of making up or stating accounts; the body of scientific principles underlying the keeping and explanation of business accounts. . . . Accounting explains the results furnished by the bookkeeper and draws the necessary inferences as to the condition and conduct of the business. . . ." In its broadest sense, accounting implies not merely a statement of facts, but a systematic and orderly development of data which point to some conclusion.

The aim of accounting both in municipal and private water utilities is, of course, to supply financial information. A good accounting system is one which records financial data in such a manner that they can be used as a guide for effective managament, as a means of determining the fidelity of persons administering funds, and as a source of information for regulatory bodies, municipal water boards, creditors, stockholders and customers.

For utilities to operate effectively without the aid of financial information is obviously impossible. A utility's budget, to be sound, must be based on past experience, as this is reflected in the financial statements of previous years; hence the importance of accurate data. Too often, small utilities overlook the importance of maintaining comprehensive bookkeeping systems. They take the attitude that the time, effort and expense of maintaining accounting data are not warranted. Thus they fail to maintain accounting records of the type needed to secure loans for extensions and improvements or to prove the need for retaining or increasing rate schedules.

Although small utilities are seldom financially able to maintain elaborate bookkeeping or accounting systems, there is little excuse for their not establishing a simple system of records which would permit them to keep such accounts as are essential to their successful operation. Accounting records which supply financial data to management, investors, consumers and regulatory bodies are as essential to a water works as plans and specifications are to an architect.

Every water utility, regardless of its size or the amount of its annual revenue, should establish an accounting system which is suited to its needs. The smaller the utility, the simpler the system should be. One such system, designed for small water utilities with an annual revenue of less than $5,000, permits the entry of all financial transactions on a single form or record. Although this form is designed to record every type of financial transaction that such a utility might encounter, supplemental records of production, meter registrations and cus-

tomer billing must also be maintained. If the number of financial transactions are few, the use of such forms may be limited to one or two a month. These may be kept in a single binder, along with the yearly summary from which annual reports to the commission are made. Larger water utilities generally require more elaborate accounting systems; however, these too should be kept within the limits of the utility's needs.

Books

The number and kind of books employed in any accounting system depend, as a rule, on the anticipated number of transactions and the extent to which it is desirable to post the data to the accounts in summarized form. Wherever numerous entries are involved, special books or general books with special columns aid the bookkeeper to summarize individual accounts at stated accounting periods for transfer to the general ledger.

The books customarily used in a typical accounting system are:

1. Operating revenue register or customer card record
2. Voucher register or disbursement ledger
3. Purchase register
4. Cash receipts register
5. Check register
6. General journal
7. General ledger.

To avoid duplication, some utilities combine certain of these books into single records. For example, the voucher register, purchase register and cash receipts register may be combined into one record known as the sundry disbursement ledger. Instead of maintaining a separate cash receipts register, the regular check book stubs are posted and reconciliations made at the end of specified accounting periods for verification against bank balances.

Other Records

Other supporting records may also be used. Plant accounting records record items of property by plant account classifications, thus making it possible to unitize them for future reference as well as for the simplification of the accounting procedures for their retirement.

Where depreciation accounting is employed, separate records are maintained for depreciation accruals in each plant account classification; for charges against depreciation reserve for plant retired; and for balances at the start and close of each accounting period.

Continuing property records are becoming more and more important to water utilities. This type of record requires constant supervision to insure that every unit of property is correctly entered under its proper account classification, and that all items of cost have been properly accounted for before the entry was made. Proper credit entries must also be made for units of property removed from the plant. When these items are identifiable in the records, they should be retired at their initial cost. Mass property or units of property which are not identifiable at the time of removal must be retired at the average unit cost of such property, based on the last unit costs computed. Retirement unit costs are usually redetermined at five- or ten-year intervals and are used until all existing units of property in that plant classification have been retired, unless the units can be identified as having been installed subsequent to the time the unit costs were last determined or revised.

Customers Accounts

There has been a marked improvement in the procedure for handling customers accounts, particularly in larger utilities, which have a great enough number of accounts to justify the use of machine billing. Meter books containing individual cards or meter sheets for each customer are classified according to type of service and rate schedule and are forwarded to the machine billing department where current charges are entered. Rate charts listing charges for different levels of consumption within each rate schedule permit billing operations to be handled speedily and accurately. Billing machines, also used by some utilities, give cumulative totals of customers' bills by rate class, total units of service (gallons or cubic feet) and total billing charges. These are passed to the general accounting department for entry into the general ledger. If billing machines are not used, entries are written on bill forms, customer card records or the customer billing register; charges are then transferred to customer bills.

Small utilities frequently use post cards to bill customers; the card is designed to show previous readings, current readings, total consumption and total charges.

Unpaid balances are usually carried forward before the current bill is calculated, to enable the billing clerk to total all charges before the final bills are prepared.

Customer accounting functions comprise:

1. The recording of essential information about each customer
2. Determining at regular periods the amount of water consumed by each customer and the amount of any other services rendered for which charges are to be made
3. Accurate billing of each customer for water consumed and other services rendered
4. Efficient collection practices
5. Prompt recording of collections and crediting of customers accounts for amounts paid
6. Maintaining customer accounting data for management's use in supervising collections and delinquent accounts
7. Supplying the general accounting office with summaries for necessary entries in the general accounting records.

Small water utilities maintain regular schedules for reading meters on one to three days each month, enabling their billing departments to prepare and send bills on the same date each month. The larger utilities, however, with larger customers lists, must rotate their billings because all meters cannot be read within the time necessary to mail all bills on the same day each month. A schedule for meter readers and the billing department divides the utility service area into zones and districts, each comprising a given number of blocks. Readings in different zones and districts are taken on specified days each month or, if billing is prepared on a quarterly basis, once every three months. The bills are usually prepared and mailed within 5 to 10 days after the date the meters are read.

Expenditures

Accounting for expenditures involves seeing that expenditures are incurred only for value received, that entries properly reflect the financial operations of the utility during each accounting period and, if a budget is in force, that expenditures are made in accordance with budgetary provisions. To accomplish these objectives, certain

procedures must be followed. Distinctions must be made between current expenses and capital expenditures, and between current expenses applicable to a particular period and those which are to be set up as assets (prepayments) and amortized over a number of periods. Expenses for a particular period should also be allocated to proper accounting classifications, depending upon the function for which the expense was incurred, such as source of supply, pumping, maintenance of mains or other classifications. It is important, moreover, to know within each function what part of the cost covers materials and what part labor or overhead. Cost accounting utilizes functional analysis as a means of establishing unit costs.

Work Order System

A work order system should be established by all water utilities, regardless of size. Under such a system separate work orders for additions to and retirements of the utility plant are recorded for each job. If construction work orders are used for other than routine additions, retirements may well be included with the construction work order, if they are kept as separate items. Any maintenance costs involved in the work must, similarly, be separated.

Purchasing

Purchasing of materials and supplies should, wherever possible, be centralized under a purchasing department in the charge of a purchasing agent. In small utilities it may be necessary to assign this job to an individual who has other duties to perform. Even under such circumstances, centralization produces better results. Municipalities usually employ a central purchasing agency, as certain classes of purchases must by law be submitted for public bidding.

Centralized purchasing results in a number of benefits:

1. The purchase of large quantities of materials and supplies makes it possible to buy at lower prices.

2. More time can be devoted to checking market conditions and finding better sources from which to purchase. Experience and special training enable a purchasing agent to recognize and take advantage of favorable market conditions.

3. Better control over inventories is afforded, giving a check on wasteful or unnecessary buying.

4. A real check on budgetary provisions is possible, as the purchasing agent will refuse to issue a purchase order without certification from the budget officer that the expenditure will not exceed the maximum limit set up for the department.

Stores Control

To avoid waste and the misappropriation of materials and supplies, some means should be provided for centralized storing. Materials and supplies withdrawn from stores are accounted for by withdrawal slips, and charged to the work or construction orders for which they are issued; this information is then entered in the permanent records of the utility. Copies of material and supply withdrawals may also be passed on to the purchasing agent to insure the proper utilization of materials.

Stores control should include the following functions:

1. Proper storing of materials and supplies

2. Proper procedures for checking in materials and recording receipts

3. Proper procedures for issuing materials and transferring them between jobs

4. Frequent physical inventories to make certain that materials shown by the records are actually on hand

5. Charging of materials and supplies to proper accounts and jobs.

Wherever possible, all materials should be held in one storeroom under the direct charge of one person. If sub-storerooms are necessary, regardless of their location, they should be kept under the full control of the central stores office. This office should be informed of the receipt of materials and supplies at sub-storerooms and of the receipt of materials and supplies which do not pass through any storeroom but are used directly on the job.

Materials and supplies received at storerooms must be inspected and counted and duplicate copies of a receiving report or of the purchase order filled out. One copy must be sent to the purchasing or accounting department for checking against invoices; the other copy is retained by the storekeeper and used to record the quantity of new materials on stock cards.

All transfer of materials between jobs should be reported to the stores office and no materials should be transferred without proper authorization.

Materials and supplies returned to the storeroom should be reported, in duplicate, on a materials return ticket, one copy going to the department returning the material and the other retained by the storekeeper. If materials are returned to a vendor after they have been recorded on stock cards, a purchase return ticket should be made out in quadruplicate and copies sent to the purchasing department, the vendor and the accounting department, in addition to the copy retained by the stores office. The stores office uses its copy to adjust stock card records; the accounting department uses its copy to credit the materials and supplies account in the general ledger and to prepare a debit memo to be transmitted to the vendor.

Materials and supplies should be charged to jobs as they are issued under a work order system. For routine maintenance and additions, however, such supplies are generally charged to the foreman as issued and allocated to the job when completed. The exact amount of materials used is determined when materials and supplies are first charged to the foreman. The materials and supplies account in the general ledger is not affected until the job is completed. At that time, the foreman submits a report showing the total material used. When these are priced, the overhead expense incurred by the handling of materials is added to arrive at the total cost of materials used. Separate reports are made for each job listing the materials used and their cost. Entries are then made charging the Construction Work in Progress Account and crediting the Materials and Supplies Account.

Payrolls

Payroll accounting involves the composition of payrolls at stipulated periods. Each employee shown as employed at the beginning of the payroll period and any employees added during that period are listed with their titles, rates of compensation, and number of hours worked each day. Records are made of employees leaving the utility's service during the payroll period or of changes in the rate of compensation or in the employees' status. If centralized payrolls are used, each department is held responsible for in-

forming the payroll division of daily time records and changes in an employee's status.

If payrolls are prepared by the individual departments, provision is made within the department for advising the payroll division or clerk of any change in the status of an employee. Payroll distributions are made from daily time sheets, time studies, job or work orders or construction work orders for maintenance, installation and construction employees and for general employees classified by title according to the type of work to which they devote their full time. If an employee devotes time to more than one class of work, the distribution is made on the basis of the time devoted to each class of work, determined by time studies on a percentage basis or by daily work reports.

If reports on employees' earnings are filed with the Commissioner of Internal Revenue and social security payments are made, special card records must be set up for each employee listing earnings for each pay period, deductions to be made and to whom the deductions are to be paid.

After the payroll has been audited and approved, checks for each employee must be made out for the net amount he is to receive and the check number entered on the payroll opposite the amount. Some utilities prefer making payroll payments in cash; a check must then be drawn for the total amount of the payroll and cash obtained from the bank. When large numbers of employees are involved, the money must be sorted, placed in individual envelopes, on which are noted the names of the employees and the amounts they are to receive, and the pay envelopes distributed. Verification of the amount received is usually required to avoid claims for underpayment. This method of payment presents a real risk of robbery during the period when the money is being transferred from the bank, prepared for payment, and distributed. Most utilities favor payment by check not only because it removes the hazard of robbery, but also because it reduces the time required to prepare and make payroll payments. It also tends to eliminate the opportunity for payroll padding.

Depreciation Accounting

Depreciation accounting should, in the author's opinion, be given greater consideration in any accounting system adopted by a utility if actual costs are to be reflected in the operation of the utility. Depreciation may be defined as a loss of service value which is not restored by current maintenance. Depreciation is incurred in the consumption or prospective retirement of utility plant from known causes against which the utility is not protected by insurance. Among these are wear and tear, decay, action of the elements, inadequacy, obsolescence, changes in the art, and changes in demand and in the requirements of public authorities.

The author has observed that there is no uniformity in the depreciation accounting practices of utilities and that the utilities do not appear to understand what this accounting procedure is designed to do. The purpose of depreciation accounting—to set aside out of current earnings sufficient money to replace units of property which have outlived their usefulness—is ignored. If depreciation allotments are not used for replacement, they become available for extensions or expansion. This procedure tends to increase plant values and permits earnings to continue

at a rate commensurate with or exceeding the original investment.

The amount established for depreciation must be determined by the needs of the individual utility, based on accurate and dependable records of past operation. If neither experience nor records are available, a table can be prepared listing each classification of depreciable plant and its value. A term life is then established for each class, generally based on estimates of the individual plant operator, taking into consideration the type of material in use, soil conditions, the effects of the elements on exposed plant and other relevant factors. There are numerous books and manuals on depreciation which give the term life of different classes of plant, and these may be consulted as a guide. The Bureau of Internal Revenue devotes considerable space in its tax manuals to allowable deductions for depreciation of different classes of property. Because it is based on information obtained throughout the nation, with liberal allowances to cover conditions which might be encountered anywhere, this material is extremely valuable.

When term lives have been established, percentages can be determined. For example, a term life of 20 years means an annual depreciation of 5 per cent; 30 years, $3\frac{1}{3}$ per cent; 40 years, $2\frac{1}{2}$ per cent; and so on. These percentages are applied to the value of the various classes of plant to arrive at an annual accrual figure. The sums of the individual accruals are charged as depreciation expenses for the year, preferably on a month-to-month basis, so that monthly expenses may not be distorted and that charges may be spread equally throughout the year. Year-end adjustments are necessary to account for retired and added plant, but the procedure is the same as the one described for plant in service at the beginning of the year.

Because of its simplicity, this straight-line method of depreciation accounting is almost universally used by utilities and regulatory bodies. Other methods such as the sinking fund method, the interest method, the retirement method and the work-unit method are also used, but will not be considered in this paper.

The importance of using the depreciation account, and charging depreciation reserves with the net loss of plant retired—whenever, for whatever reason, units of property are removed from a plant—instead of charging the loss to maintenance, must be emphasized. Too often, when plant equipment is removed and replaced, the cost of replacement is charged as maintenance instead of capital. Because labor, material and overhead were undoubtedly less expensive when the equipment was first installed than they are today, property which required an original investment of $500 might require as much as $1,000 or $1,200 to be replaced today. This increase in investment is essential to the utility for future earnings and depreciation. If charged to maintenance, an investment may be recouped because current revenues will support it. The requirements of the future are neglected, however, and when revenues and earnings are at a declining ratio the utility is deprived of any earning or depreciation on the increase in plant investment because of improper accounting procedures.

Cash

Cash is one of the most liquid assets of the utility and great care must be exercised to see that proper safeguards

are provided by a system of internal check. All cash receipts must be deposited regularly in the bank and all payments, except the small amounts handled through a petty cash fund, must be made by check. Employees charged with the responsibility of receiving or handling cash should be bonded as a safeguard against defalcation or misappropriation of the utility's funds.

Customer account collections comprise the most important cash receipts of the utility. Small utilities with limited numbers of customers experience little difficulty in handling collections. The larger utilities, however, are required to provide adequate equipment for the use of the collection staff. Thus registers or cash drawers are assigned to the individual collectors with specified amounts of cash for change, for which the collector is responsible. Rubber stamps or other means of stamping bills *Paid* are also provided.

No cashier should accept payment unless it is accompanied by a bill. Provision must be made, however, for the speedy issuance of duplicate bills when payment is tendered without one. Similarly, if no bill accompanies remittances received by mail, a duplicate bill must be issued and attached.

All checks and bills should be turned over to a cashier for appropriate handling. Each cashier must at the end of the day prepare a report of collections made and turn over all collections received, with the cashier stubs to which they refer, to a head cashier or other designated employee. Total collections must be audited for each report to see that they are in agreement with the collections received; any disagreements must be adjusted. Recapitulation should be made, in duplicate, of the total receipts for the day, based on the individual reports submitted by each cashier. One copy must be retained in the cashier's office and the other sent to the customers' accounting department with the cashier's receipt portion of each bill collected.

All receipts collected should be deposited to the credit of the utility the day after collection. All disbursements, except those made through the petty cash fund, should be made by check and the cancelled checks attached to the invoices or vouchers to which they refer. Small cash payments must be reported on a petty cash voucher and reimbursement made to the person handling the fund.

Bank Statements

Reconciliation of accounts should be made immediately after receipt of the bank's statement. Cancelled checks should be compared against the bank's statement to see that they are in agreement and each check examined for authorized signatures and proper endorsements. Unpaid checks outstanding must be deducted from the bank's balance, and any unrecorded deposits added. The result should agree with the Cash Account balance in the general ledger; any discrepancy must be checked to bring the accounts into balance.

First mortgage bonds, revenue bonds, debentures and other restricted funds should be treated as special fund accounts and entries made in accordance with established accounting practice.

Plant accounting is an important part of any well-rounded accounting system and deserves a real place in every utility's accounting procedure. Although volumes have been written on the subject, this paper can do no

more than mention that a utility's investment in plant and property cannot be accurately appraised without the efficient operation of a plant accounting system.

Financial Statements

Financial statements are prepared from the summary results reflected in the general ledger when all clearing accounts have been properly distributed, adjustment entries made, expense accounts closed out to the income account and the net balance transferred to the surplus account. The two statements of greatest importance in the preparation of financial statements are the balance sheet and the income statement. The latter is prepared from subsidiary records of income, operating expenses, depreciation and amortization, extraordinary property losses and taxes. If income other than utility income is received, it must be added to net utility income after operating revenue deductions have been made. Interest and other charges are deducted from this total to arrive at the net income, which is added to the surplus account balance at the beginning of the period. Credits to surplus, if any, are also added; and, from this total, debits to the surplus account are recorded as dividend appropriations on preferred and common stock, with miscellaneous reservations and miscellaneous debits to surplus. Total debits are then deducted and the remainder represents the amount of earned surplus at the end of the period.

The balance sheet is a summation as of a given date of the assets and other debits, liabilities, capital stock, surplus (or deficit) and other credits. Before preparing a balance sheet, a trial balance, reflecting debit and credit balances of all ledger accounts, is customarily prepared. When these have been totaled, if the total of the debit balances equals the total of the credit balances the ledger is considered to be in balance, and the balance sheet can be prepared.

The primary purpose of the balance sheet report is to show the financial condition of the utility as of a given date. Such reports, particularly at year-end periods, are prepared for distribution to the management and the board of directors and are included in annual reports to stockholders, bond holders, regulatory bodies and financial institutions such as banks, insurance companies and investment houses, which are interested or likely to be interested in the financing of the particular utility property or in the sale of its securities to the general public. Management, of course, uses such reports to map out future plans and policies for the utility. Current monthly balance sheet reports and income statements enable management to institute corrective measures and adjust operations as they become necessary.

Every utility must be supplied with financial information on its investment, revenues, expenses, depreciation and taxes if it is to succeed and prosper. Without such a source of information, the utility would find it almost impossible to secure financial aid or relief when needed. It is, therefore, essential to the best interests of a utility, and of its investors, customers and employees, that an adequate system of accounting be established and used effectively.

Mobile Radio Communications in California

By M. J. Shelton and N. J. Kendall

A panel discussion presented on October 26, 1950, at the California Section Meeting, San Diego, by M. J. Shelton, Gen. Mgr. and Chief Engr., La Mesa, Lemon Grove and Spring Valley Irrigation Dist., La Mesa, Calif.; and N. J. Kendall, Chief Engr., San Jose Water Works, San Jose, Calif.

Telephone Company Service—*M. J. Shelton*

The sole function of the La Mesa, Lemon Grove and Spring Valley Irrigation District is the distribution of domestic water to two incorporated cities and a large unincorporated area, comprising 22,000 acres within a large, rapidly growing region immediately east of San Diego. Considerable distances are covered by the various crews in maintenance, operation and construction work, and it is important that the men in charge of the work be readily accessible to the office as well as to the superintendent.

Shortly after World War II, serious consideration was given to installing some form of mobile telephone communication. Because there is no fire or police department radio system available, a radio communication system operating under a special license for the district's own use, similar to that used by police or fire departments, was considered. The terrain, however, is rolling and somewhat mountainous, and the installation of many relay stations would have been necessary to obtain full coverage. Furthermore, the initial cost of the equipment and the continuing cost of manning such a station, on a 24-hour basis, precluded the adoption of such a plan.

Telephone Company Service

It was at about this time that the local telephone company initiated its mobile car telephone service. Upon investigation of that service, it was found that the telephone company paid for all of the initial equipment and that service on a 24-hour basis was available upon payment of a nominal installation fee and a monthly service charge. Two major types of service were offered, "urban" and "highway." Each type offered what is known as "general" service; in addition, the urban type included a "dispatching" and a "signaling" service.

In general service, whether urban or highway, general conversation is permitted, on two-way telephone service, between any regular telephone and any mobile unit, or between two mobile units.

In urban service the telephone company attempts to cover an entire metropolitan area, which in the San Diego district is approximately 40 miles wide. It is possible to originate or receive calls anywhere within that area.

Highway service operates over a different wave length and uses different pickup stations. These stations are located along the highway to permit

continuous coverage between metropolitan areas, thus offering special advantages to large trucking companies. The superintendent or manager of the district, who often travels between San Diego and Los Angeles, has found this service a great time-saver, enabling him to discuss urgent business with the office.

Two-way dispatch service between a designated dispatch office and a customer's own mobile unit permits transmission of messages from the customer's switchboard or dispatch office, but eliminates the possibility of originating calls from any telephone.

One-way signaling service to mobile units merely transmits a signal to the driver of the truck to comply with prearranged instructions.

TABLE 1

Charges for Equipment on Mobile Units

	Installation	Monthly	Min. Monthly Service
General Service	$50.00	$25.00	$7.00
Dispatching Service	50.00	25.00	7.00
Signaling Service	25.00	12.50	5.00

Cost and Upkeep

What such a service costs is one of the first questions which is always asked. The costs listed in Table 1 are those of the local telephone company, and apply throughout California, but may vary considerably in other parts of the country.

Charges for individual calls are based upon "message units." Their definition can become rather involved and will differ with the type of service offered. Using five mobile phones during a three-year period, the district has always operated within the monthly minimum charge, indicating that such a minimum is sufficient to cover a normal volume of business. When a call exceeds the minimum time, there is an additional charge based upon message units, and whenever the allotted minimum number of message units is exceeded, a further charge is made, also based upon message units. The monthly charges in Table 1 are broken into two components, the larger of which covers capital investment in the equipment, maintenance, damage, fire or theft, and obsolescence. The smaller, the minimum monthly service charge, covers calls originating from the mobile phone.

The telephone company makes a semiannual check of the radio frequency employed, and services the equipment whenever troubles are reported. If a leak truck is on call around the clock, the telephone company even will service it on the job, thereby making it unnecessary to take the truck into San Diego and away from the emergency work.

Operation of System

In approximately three years of service, this equipment has proved its value very clearly, not only to the district, but to the public. There have been many times when an hour or more was saved in making emergency repairs because the superintendent was able to coordinate the movement of men and materials most effectively. In addition, offices and shops no longer need to delay acting upon telephone complaints until the proper workmen return to their base, for a call to their car will quickly advise the men of the emergency and direct them to the work. Likewise, considerable amounts of travel and man-hours are saved by

being able to intercept a crew operating in the general vicinity, thereby increasing the crew's output and the general efficiency of the district. Such improved service makes a favorable impression on the public and, in turn, produces better public relations.

Under present international conditions, with serious attention being given to civilian defense, interest has been expressed in the relative merits of telephone utility-operated mobile telephone communications and privately operated radio-telephone systems. Because the telephone company gives careful consideration to the nature and normal hours of a business when allocating phones to the various channels, nonessential uses predominate on a given channel. Should an emergency arise, therefore, that channel would be freed for users operating on an emergency basis. In this respect, the mobile telephone system of the telephone company has a decided advantage over private radio-telephone communication. In a defense emergency, as well as in the normal functioning of a civilian defense agency, calls can be made directly, from any phone, without having to be relayed through an operator at a central station.

Although service is guaranteed only within a 25-mile zone, satisfactory communication has been maintained with cars as far as 50 miles away, although these operate under "urban" service. In addition, whenever the manager or superintendent is out of the city, the office can still remain in touch with him; the telephone company merely needs to know his approximate route of travel and then, through its operators, it will continue along that route until the call is picked up.

All in all, the experience of the district with the service has been most gratifying, and the value of this new operating tool has been definitely established.

User-Operated Service—*N. J. Kendall*

It may seem axiomatic that the operation of a water works in this modern age requires a modern communication system. Although the nation's water works have been brought up to date with the installation of modern pumps, switchboards and automatic equipment, however, there still is a reliance on the older, more direct methods of communication. Not many water works have facilitated communication with the installation of radio systems. Today it is possible, without incurring undue expense, to install radio transmitters and receivers in key water work vehicles. Three such radio systems are now available. In the simplest method, a land transmitter station beams to an unlimited number of mobile or land units which can receive but not return the calls. In the second type, the mobile unit can return the central station's call but cannot communicate with another mobile unit. The third type makes use of all three operations: land station to either land station or mobile unit, mobile unit to land station, and mobile unit to mobile unit.

The advantages of radio communication over other mobile means of communication can be listed briefly: [1] there is no limit to the number of calls that may be made, [2] there is no operator through whom calls must be made, [3] there is no delay

in long-distance communication, and [4] a means of communication is readily available at any time of the day or night. Radio transmitters and receivers can be installed in any vehicle; it is not necessary to install heavier types of generating or battery equipment.

Licensing and Controls

All radio communication within the United States is controlled and regulated by the Federal Communications Commission. The FCC has issued various rules and regulations governing the operation of industrial radio services. Summing up its powers, briefly: it controls the granting of applications and licenses; it formulates the technical standards and development of radio service; it determines the procedures necessary for obtaining station licenses; and it formulates the policies governing assignment of frequencies, license terms, changes in equipment, frequency stabilization, modulation requirements, power, antenna heights, transmitter control requirements, transmission measurements, radio station tests, types of communication, operator requirements, and records to be kept by each station.

The industrial radio services licensed by FCC are divided into various parts: the power radio service, petroleum radio service, forest products radio service, motion picture radio service, relay press radio service, special industrial radio service and low power industrial radio service. Water utilities are grouped under the power radio service.

Those who are engaged in generating, transmitting, collecting, purifying, storing or distributing, by means of wire or pipeline, either electrical energy, artificial or natural gas, or water or steam, for use by the public or by the members of a cooperative organization, are eligible to operate radio stations under the power radio service. The frequencies available for base and mobile stations in the service are 37.46 to 37.86 megacycles (mc.), 47.70 to 48.54 mc. and 153.41 to 158.25 mc.

FCC regulations require that all radio users within the various groups cooperate in deciding frequencies to be used so that interference between operators can be reduced to a minimum. All radio users grouped under the power radio service in California are represented by the Southwest Radio Committee for Utility Radio. This committee recommends the frequency band to be given each user prior to submission of an application to the FCC, in order to prevent overlapping and interference. The range of this type of radio is limited to approximately 50 miles, in order to enable the use of each band in four or five areas in the state without overlapping and jamming. Persons operating the land or base station in each unit must hold restricted radio-telephone operator permits. Mobile units may be operated by any person authorized by an organization licensed to operate the equipment. These licenses or operator permits are easily secured and require only the forwarding of certain forms to Washington.

Equipment and Installation

A variety of equipment, manufactured by several companies, is available for such radio installations. In general, prices are the same for similar units. Units vary in output wattage but the technical limitations of the equipment are distance and line-of-sight. The approximate limit of a unit without a relay station is 50 miles. Because all of this equipment employs

the line-of-sight transmission of FM (frequency-modulated) radio, it cannot be used in very rugged country without relay stations. If an unobstructed line of sight is maintained between units in communication, messages can be delivered without any trouble.

Although the cost of radio equipment may at first seem high, it is not out of line with costs of other labor-saving devices. With the exception of the automobile or truck, no piece of equipment is used more continuously. The installation of a 40-w. land station costs about $1,200 while the average price of a 30-w. mobile unit, installed, has been estimated at $500–$600. Investment in one mobile unit enables a single $1,500 pickup truck to perform almost as much work as two trucks. Remote control units expand the operation of a land or base station by enabling conversation from several rooms or buildings in one location to pass through a single transmitter to other land stations or mobile units. These control units cost about $250. No changes in the vehicles' standard electrical equipment are required. The increase in maintenance has not warranted investments in large generators or batteries. Only when the radio must be kept on for long periods of time, is an increase in generator or battery capacity necessary.

Maintenance and Operation

Maintenance cost is not excessive. During the past two years expenditures for parts have averaged only $1.20 per month per unit. All radio equipment is maintained, under contract, on a 24-hour basis by a licensed radio technician at the monthly rates of $15 per land station and $7 per mobile unit. In addition, a preventive maintenance program has been set up which requires each set to be checked monthly for defective parts and tuning. The radio technician, who holds a Class I license, furnishes all equipment and tools, with the exception of several items of special test equipment used for certain types of radio units.

The operation of the radio equipment is very simple and has occasioned little trouble. Most difficulties have been caused by operators who did not follow instructions. The actual operation of the equipment is simpler than using a dial telephone. It is only necessary for the operator to pick up the speaker, press a button and start talking. He calls the unit desired and, upon obtaining a response, delivers his message. As soon as the conversation is completed, both parties sign off.

The equipment used at the San Jose Water Works consists of two land stations, a remote control unit, and twenty mobile units. One land station and the remote control unit are located in the main offices in San Jose; the other land station is located in the Los Gatos office. All mobile units are installed in vehicles used by key officials (general manager, engineers, superintendents) and in foremen's trucks, pump trucks and service trucks.

Economies and Other Advantages

Savings accomplished by the use of mobile radio equipment are difficult to determine. It can be determined accurately that four servicemen are now saved three trips a day into the office for orders—a saving of from 1½ to 2 hours each, or a total of 6 to 8 man-hours per day, plus a corresponding saving in truck mileage. The savings accomplished in dispatching a crew to a bad leak as soon as it is reported cannot be so easily determined, however. The loss of only half an hour

in isolating a bad break in an 18-in. line can cause considerable damage.

Closer coordination can also be achieved in repairing leaks or carrying on the regular construction work involved in water works improvement. Much time and labor are thus saved in the operation of special water works problems. The problem of coordinating men and material during difficult or complicated operations is greatly simplified and a smooth control of details with less men and equipment can be achieved. By using radio equipment, supervisory personnel can also be released to give a greater proportion of their time to actual supervision; they are not required to make trips into the office and can be reached almost immediately, as needed, by radio. In addition, relations with the general public are greatly improved as a result of complaints being handled in a matter of hours or minutes, whereas, in the past, days were required to take care of the same complaints. This equipment, with proper usage, makes it possible to double the work potential of vehicles in which it has been installed.

Three-way radio communication has proved to be a valuable addition to the San Jose water works, permitting far greater mobility and coverage of larger areas per vehicle. In addition, the whole organization has been brought into closer contact with the various operations involved in running a water works system. Radio communication has made possible a more centralized control of all operations and has resulted in a closer knit plan of operations, encouraging the execution of this plan with a maximum of efficiency and use of equipment, and a minimum loss of time and effort.

A Continuous Odor Monitor and Threshold Tester

By H. H. Gerstein

A paper presented on April 30, 1951, at the Annual Conference, Miami, by H. H. Gerstein, Chief Filtration Chemist, South District Filtration Plant, Water Purif. Div., Chicago, Ill.

An apparatus for the continuous monitoring of odors and testing for threshold odor in water supplies was developed by the author at the Chicago South District Filtration Plant for the purpose of improving odor control in water treatment.

Because there is a physical limit to the number of odor determinations that a laboratory technician can make, the plant's routine tests for hot threshold odor in raw and finished waters are made at two-hour intervals; during periods of serious odor, tests are made at hourly intervals. As the character and intensity of odors may change in the intervals between odor tests, it is often difficult for the chemical control engineer to make the necessary changes in treatment. Use of the continuous odor monitor and threshold tester, shown in Fig. 1, not only provides a quick means for determining the type and intensity of an odor at any given time, but also makes possible a frequent check on the efficiency of the treatment process.

Qualitative Odor Tests

The continuous monitoring device provides a qualitative indication of the character of the odor and a fair indication of its intensity. As shown in Fig. 2, water is passed continuously through an electric heater, where it is quickly heated to approximately 120° to 140°F. The heated water is then carried to a spray nozzle inside an enclosed glass cylinder or jar, where it is atomized. The odor released inside the jar can be sniffed by an operator through an opening in the top. A standard glass osmoscopic nosepiece inserted in the opening aids considerably in detecting odors released inside the jar.

It has been the author's experience that more accurate determinations of the character of an odor can be made by monitor test than by the standard method. The optimum temperature for testing hot odors in a monitoring apparatus appears to be between 120 and 130°F.

Quantitative Odor Tests

The standard method (1) of threshold odor testing requires the dilution of portions of the sample with odor-free water. This is accomplished in Erlenmeyer flasks, holding 200 ml. of the diluted sample which are then heated to 140°F. The threshold is calculated as the reciprocal of the most dilute portion giving off a perceptible odor. The method requires performance by a well trained laboratory technician using careful technique to obtain reproducible results.

By use of an auxiliary device on the monitor, shown in Fig. 3, a method is provided for making quick and fairly accurate quantitative determinations of the odor threshold on a continuous basis. The rate of flow of the water to be tested and the flow of odor-free water are measured separately by means of rotameter flowmeters. The mixture of the two waters is then carried through the continuous odor monitor.

The ratio of the rate of flow of the sample to that of the odor-free water is changed until the odor is only barely perceptible. The threshold odor is calculated from this dilution according to the following equation:

$$\text{Threshold Odor} = \frac{S + O}{S}$$

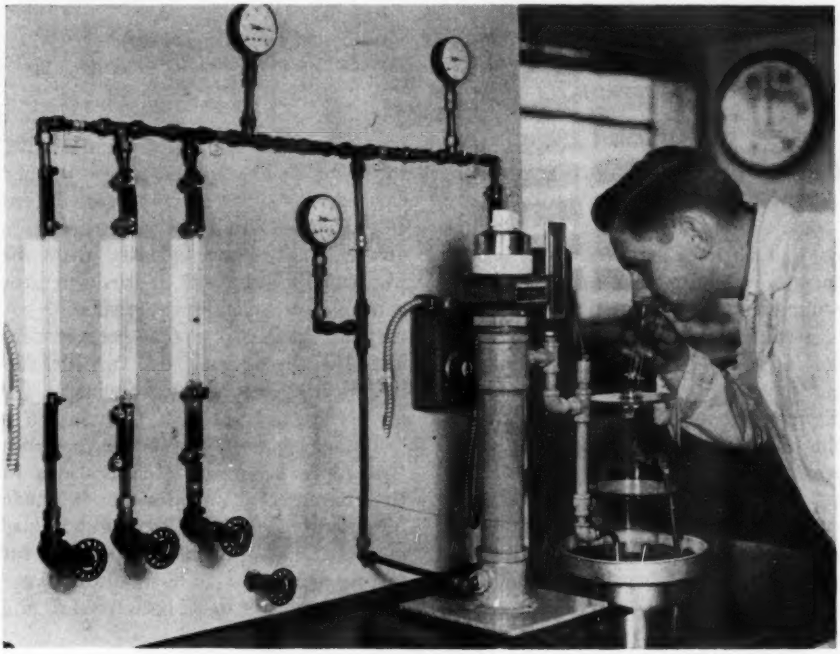

Fig. 1. Continuous Odor Monitor and Threshold Tester

The apparatus shown above not only provides a quick means for determining the type and intensity of an odor at any given time, but also makes possible a frequent check on the efficiency of the treatment process.

in which S is the rate of flow of sample and O is the rate of flow of odor-free water (both in milliliters per minute).

Construction of Apparatus

The apparatus may be constructed at low cost from easily obtainable, standard parts.

The continuous odor monitor shown in Fig. 2 has a 2,000-w. Chromalox * immersion heater unit with a three-heat switch, mounted in a heater housing constructed of 2-in. pipe and fittings. The bottom of this unit is welded to a steel plate which acts as a base. Heated water is piped to the brass spray nozzle which releases approximately 560 ml. of water per minute, at a pressure of 25 psi. A minimum pressure of 15 to 25 psi. is required in the sampling line for optimum operation of the spray. As described earlier, the spray nozzle is set inside a glass bell jar with an opening in the top to permit detection of the odor.

Because it was found that standard laboratory bell jars were likely to crack when heated, pyrex glass jars were specially prepared by a local glass blower for approximately the price of a standard bell jar. The jar is set in a drainage pan with a connection near the bottom to carry away water discharged by the spray. A standard 10-in. cake tin can be used for this purpose.

If for any reason the flow of water to the heater is reduced or stopped, protection against overheating is provided by the bulb of a thermal cutout switch, installed in a tee fitting in the discharge pipe, by means of which the electric circuit can be opened. A standard industrial thermometer is also installed in a tee fitting to register the temperature of the water flowing

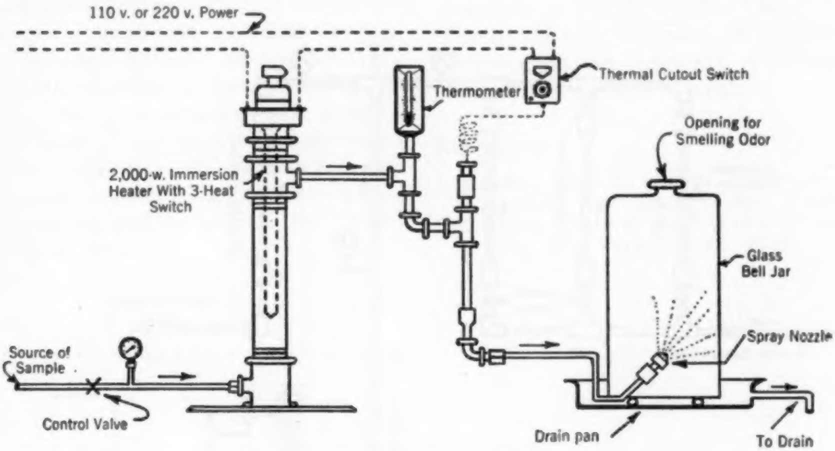

Fig. 2. Continuous Odor Monitor

The continuous monitoring device provides a qualitative indication of the character of the odor in the water and a fair indication of its intensity. The heated water is carried to the spray nozzle inside the enclosed glass cylinder, where it is atomized. The odor released inside the jar can be sniffed by an operator through an opening in the top.

* A product of Edwin L. Weigand Co., Pittsburgh, Pa.

to the spray nozzle. The temperature of the water coming from the heater can be controlled within the 120° to 140°F. range by adjusting the rate of flow through the heater and by selecting one of the three heat outputs in the immersion heater. Although a thermostatically controlled heater unit would be more effective for this purpose, one could not be found which would give the desired control because of the inadequate water storage capacity of the heater housing. If desired, closer control of water temperature can be obtained by using a rheostat-controlled heater unit.

The total cost of the odor monitor, not including the labor required to assemble the parts, was less than $75.

The odor threshold tester shown in Fig. 3 consists primarily of tiny laboratory-type rotameter flowmeters arranged to measure the flow of sample and odor-free water Three rotameters are connected in parallel on the sample supply line to measure flows ranging from 1 ml. per minute to 1,120 ml. per minute. The capacities of the three rotameters are: 1 to 18; 10 to 130; and 40 to 1,120 ml. per minute. The rotameter used for measuring the odor-free water flow has a capacity of 40 to 1,120 ml. per minute. Each rotameter is equipped with a $\frac{1}{8}$-in. needle valve for adjusting the flow rate. For best control of flow, the pressure of both the sampling and odor-free water should be about the same. If pressures are too high, or if they fluctuate, it is desirable to install pressure regulators

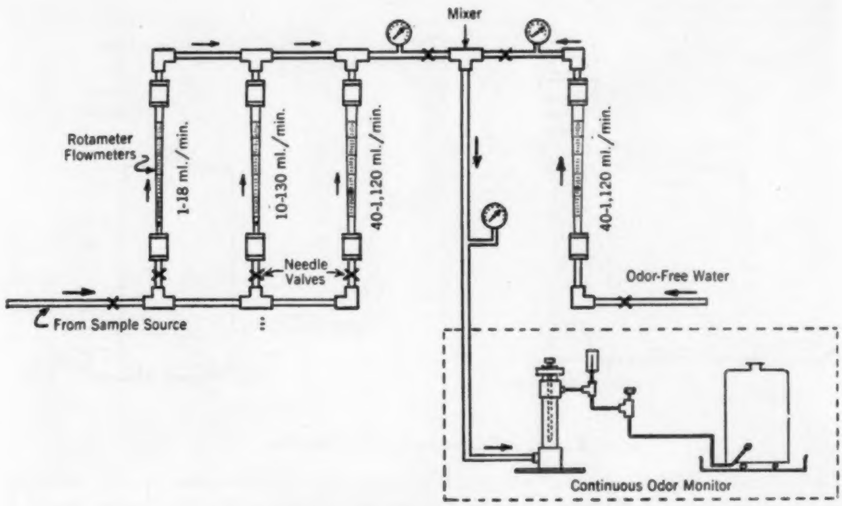

Fig. 3. Continuous Odor Threshold Tester

By using an auxiliary device on the monitor as shown above, a method is provided for making quick and fairly accurate quantitative determinations of the odor threshold on a continuous basis. Rotameter flowmeters separately measure the rate of flow of the water to be tested and the odor-free water.

on each supply. Assembled frames of three or more different-capacity rotameter-type flowmeters, complete with control valves, can be purchased from a number of manufacturers. The cost of parts, not including labor, for the threshold tester shown in Fig. 1 was less than $100.

Individual odor monitors may be used for the continuous monitoring of samples of water in each of the several stages of treatment, including the raw, settled and effluent waters. A very effective method of demonstrating the efficiency of a particular odor removal treatment is to have two continuous odor-monitoring devices installed side by side, one connected to the raw water supply and the other to the treated effluent water.

Acknowledgment

The author wishes to acknowledge the help received from John Collins, Mechanical Engineer, and Norbert Davoust, Senior Sanitary Engineer, both of the plant staff, in assembling and testing the device described. The work was carried on at the Chicago South District Filtration Plant, which is operated under the direction of the Commissioner of Public Works, Oscar E. Hewitt; the City Engineer, W. W. DeBerard; and the Engineer of Water Purification, John R. Baylis.

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Photographing Water Wells

By Claude Laval Jr.

A paper presented on October 26, 1950, at the California Section Meeting, San Diego, Calif., by Claude Laval, Jr., Fresno Camera Exchange, Fresno, Calif.

ALTHOUGH underwater photography is not a new subject, most efforts to construct underwater photographic equipment both in this country and in Europe have met with only varying degrees of success.

The reader is familiar with the ocean-life photographs which Beebe (1) has made from within the ball-like structure in which he was lowered to the ocean floor. The efforts and difficulties which attended the lowering of unattended camera equipment have also been widely publicized (2). Any search through camera patents will disclose a number of contrivances which are intended to take photographs underwater in wells. For one reason or another, however, these devices have never produced the desired results.

A considerable number of photographs can be taken during a single descent underwater in a bathysphere such as Beebe's, which permits operation and reloading of a camera by a man inside a protective enclosure. Water well photography is of necessity confined to a narrow working area, and most earlier devices have been unable to expose more than one picture at a time without returning the equipment to the surface to advance the film.

Surface Control

The author's camera can expose 800 double sets of pictures before the equipment is hoisted for reloading. When the exact location of trouble in a well failure is not known, the time which can be saved by an apparatus which will make numerous exposures while searching inch by inch along the well lining is of obvious importance. Moreover, each exposure made can be controlled from the surface. This ability, combined with the depth meter, makes possible a detailed study of the entire lining of the well.

Diagnostic Use

Drilling a well can be a costly operation, the degree depending, of course, on the depth and conditions under which the well is drilled. The deep wells used for irrigation on the west side of Fresno County and the San Joaquin Valley in California cost more than $20,000 each; yet some of them have developed casing failures shortly after installation.

Most water works men are familiar with the diagnostic use of the impression block (Fig. 1) which, in the past, has been the most important means of discovering from the surface of a well just where the trouble lay. Wells can

be repaired if the source of the difficulty can be determined. The indecision and disagreement attendant upon interpretation of the block impression has frequently caused serious damage to the casing and resulted in (Fig. 2). Photographs have often disclosed incipient difficulties which would have resulted in serious damage to the well casing had the regular procedure of repair been carried out, following use of an impression block; in all

Fig. 1. Lead Impression Block

The impression block has been used as a means of determining the area of difficulty in a well from the surface of the well. This is a block made of the break shown in Fig. 2.

the abandonment of highly expensive and necessary wells.

One cannot question the value of a camera that can be lowered to the area of suspected difficulty and produce photographs which reveal the exact condition of the well both at the site of the damage and above and below it probability the wells would have had to be abandoned as a result.

One of the more interesting uses to which the underwater camera has been put has been the charting of well histories. Records are being made of the interiors of the wells, and a photographic reference file is being

developed for each. A cooperative plan had already been established, on a long term basis, between the pump installing companies and the Pacific Gas and Electric Co., by which it is hoped to bring about a clearer understanding of why certain conditions arise in well operations. Without question, a means can be found to establish the most effective means of joint welding, the types of materials best suited to well casings, soil actions on well casings and the causes of certain types of behavior encountered in wells. Experiments of value to the entire water industry can also be conducted.

One of the first problems encountered by the author was the inevitable presence of a layer of oil—sometimes as much as 100 ft. deep—on the surface of the water, introduced into the well, of course, by the lubrication of the underwater pump. As such a coating would cover the lenses when the equipment was lowered, a means had to be devised to repel the oil, permitting the lenses to pass through it and remain clear.

Fig. 2. A Well Break

This photograph, taken at a depth of 665 ft., shows a bad break at a weld in the well casing. The black bars and triangular spot are the legs and plate of the camera's light holder.

Underwater pressure also had to be taken into account in the construction of an adequate waterproof receptacle for the camera and the light source which must, of necessity, ac-

company it. The solution adopted was to seal the camera, with its electric motor and stroboscopic condensers and tubes, into a heavy steel tube.

Camera Construction

The camera head, with the two lenses contained in drilled holes, consists of two steel plates, with a total thickness of $1\frac{7}{16}$ in., held by 20 bolts. Its source of light is a stroboscopic globe buried in a $2\frac{1}{2}$-in. plastic cylinder. Three legs, protruding from the camera head, hold the light source, which uses 3,000-v. flashes of power. The camera itself is 9 ft. long and approximately 8 in. wide. Its steel container or 'bomb' is streamlined to prevent the equipment from being caught on obstructions in the well. Film of 35-mm. size is used, transported by a motor.

Both lenses of the camera, which were specially ground, produce images on the film with each flash of light, no shutter being necessary within the dark confines of the well. Diagnosis of the difficulty can be made immediately upon the return of the equipment to the surface by using a changing bag and a field development kit. The negative is read with the aid of stereoscopic hand viewers, although under certain conditions a third dimensional slide will be projected on a screen.

Although color film has been used in the camera, the circumstances under which this type of field development must be made usually preclude its use.

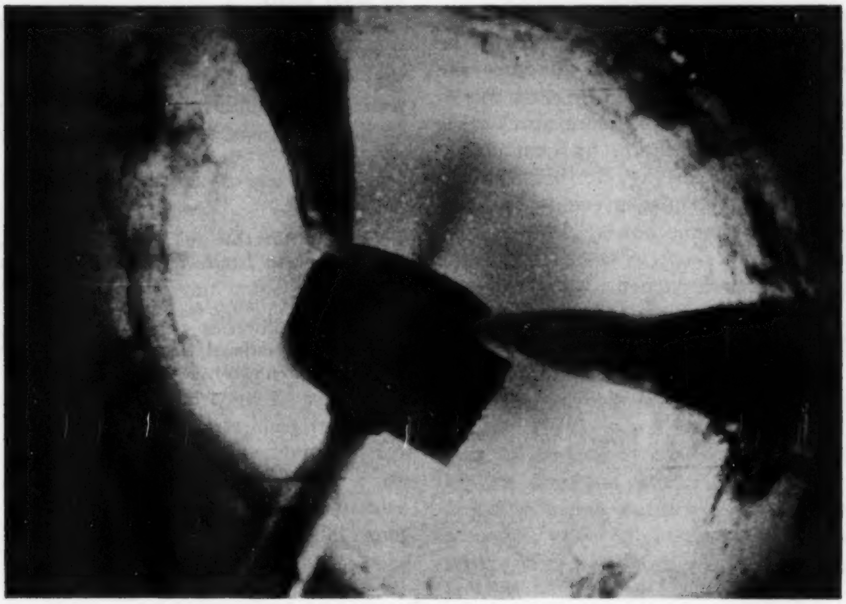

Fig. 3. Oval Well Casing

External pressure can cause the well casing to acquire an oval shape; this tends to weaken the casing and also prevents the passage of pump bowls.

Air temperatures may range from below freezing in winter to 120°F. (under a protective canopy) in summer. Field development of color film always demands a constant temperature.

Use

Among the more important facts established by well photographs is that the chief areas of difficulty usually develop at or near the welded joints. Other damage appears to be caused by folds which in turn are probably brought about by earth movements. External pressure also causes the casing to acquire an oval shape, as illustrated in Fig. 3; this tends to weaken it and also prevents the passage of the pump bowls. Photographs will clearly show whether or not the perforations are open.

It has long been thought that pipe ruptures vertically for long distances, but the author has encountered no photographic evidence to substantiate this theory. The longest rip which the photographs have disclosed extended approximately 12 in.

The author's camera has been operated without difficulty in a lined water well at a depth of 2,000 ft. and in an oil well, from which the fluid had been removed, at 4,700 ft. The camera can be used in unlined as well as in lined wells.

With greater use, the author found it necessary to adapt the equipment to the varying conditions of each job; thus, the possibilities and value of the work were advanced with the passage of time.

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Automatic Pump Control

By M. E. Rogers

A paper by M. E. Rogers, Project Engr., Builders-Providence, Inc., Providence, R.I., presented on September 29, 1950, at the Rocky Mountain Section Meeting, Santa Fe, N.M., by G. E. Reipe, Engr., Builders-Providence, Inc., Chicago, Ill.

IN these days of rising operating costs and decreasing surpluses, water works management is on the alert for ways and means of widening the shrinking gap between income and outgo. One of the simpler means of accomplishing this end is to reduce the size of the operating staff. Not only does a shortage of skilled workers make this imperative, but, in addition, substantial savings can sometimes be effected by using automatic controls wherever possible.

One of the most important applications of automatic controls within the water works field has been its use in the control of pumps in water works or distribution systems. In view of the present inadequacy of water revenues, savings effected by automatic pump control can be very significant. As an added value, automatic control can often function more reliably than manual control.

Automatic pump control may be divided into five major categories, according to the actuating factor involved in operation:

1. Pressure control
2. Level control
3. Time cycle control
4. Remote supervision
5. Pressure-flow control.

Combinations of these systems may be suitable and desirable for given installations, but it is the intent of the author to discuss only the principal features and applications of the classifications listed, with but passing reference to combinations.

Pressure Control

The simplest type of automatic control is that offered by a pressure switch installed on the pump discharge line. The switch is set to close the pump circuit whenever pressure falls below a predetermined minimum. If the switch is equipped with a differential, the contact can be made to open when pressure reaches a given maximum. This type of system is similar to the well known domestic water supply installation in which water is pumped from a well or other source into a pressure tank. When the tank is full, the pump is shut off and normal supply is obtained from reserves until pressure again falls below the desired minimum. To prevent the pump from starting and stopping too often, the tank is partially filled with air which acts as a cushion, expanding or being compressed to maintain pressure within the desired range. Proper air volume is automatically maintained by a pump or other means. Such systems are frequently used in small towns, hospitals and other institutional or small supplies. Their design has been ably described by Salvato (1).

The inability of commercial pressure switches to distinguish between short-lived surges, when control is not necessary, and low or high pressure periods when it is necessary, is a weakness of the pressure switch control system. To guard against faulty operation caused by surges and to prevent too frequent starting and stopping of the pump, a differential should be established between the points at which the switch will cut in at low pressures and cut out at higher pressures. Although switches with adjustable differentials are available, the same results can be accomplished with a thermal time delay device which will prevent the unit from starting before a given period of time and will make its starting at that time depend upon whether the pressure remains low. Switches which incorporate both time-delay features and differential adjustments are also available.

Pressure control is frequently applied to booster stations supplying elevated tanks or sections of distribution systems. If the connection is direct and there are no substantial draw-offs between the pump and the pressure center or tank, the controls will function reasonably well. If the distance is great, however, or if there are substantial draw-offs, a means must be provided to compensate for pressure drops in the transmission line. Installation of a tank-level or pressure telemeter system which will determine line conditions and relay the information back to the booster station offers one solution to this problem. This and other methods will be discussed in greater detail later in this survey.

Level Control

Where suction is being taken from a ground-level reservoir, and the pumps discharge into an elevated standpipe or tank or into a closed section of the distribution system, better and more sensitive control can be maintained by using the level of water in the tank rather than the pressure. This method may be applied to an unlimited number of pumping units and provision can be made to start or stop the pumps at any predetermined minimum or maximum level. Frequently it is desirable to cut in the various pumping units at different falling levels and either to stop all pumps at a predetermined maximum level, or successively cut out the various pumps, in reverse order, as the levels rise.

Level control may take two forms, depending on the distance of the tank or reservoir from the booster station. If the booster station is close by, any type of level-sensing unit may be used: a simple float switch; electronic or resistance probes; float, air bubbler or diaphragm bell-operated indicators or recorders equipped with adjustable contacts. Of these, the direct float-operated unit is the most convenient and reliable, when it can be used. If elevated tanks or other pipes are situated nearby, a pressure gage graduated in feet as an altitude gage can be connected to the standpipe or elevated tank to indicate the level of the water, and the gage may be equipped with electric contacts to start and stop the pumps at predetermined levels. This method is not exact because the Bourdon tube mechanism yields very little power to close the contacts.

If greater accuracy is required, a more sensitive time-impulse control mechanism, such as the "Chronoflo" * shown in Fig. 1, can be used. This

* A product of Builders-Providence, Inc., Providence, R.I.

system consists of a synchronous motor-driven cam and a cam follower arm which is positioned by the primary pressure element. Depending on its relative position, the follower arm rides the surface of the cam for a given period of time during each revolution. When the follower arm is on the cam, an electric contact is made to transmit a signal the duration of which is directly proportional to the pressure. At the

Provision may be made for either an indicating dial or a chart recorder.

If the tank, standpipe or pressure center is distant from the booster station, an electric transmitter must be installed at the tank and a receiver in the booster station. Transmission may be made over private or leased telephone circuits.

Only two wires are required for transmission if power of regulated fre-

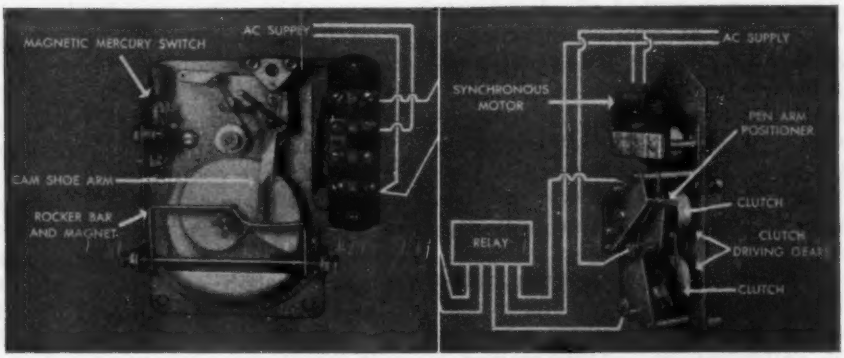


Fig. 1. Time-Impulse Type Control Mechanism

A time-impulse control system affords great accuracy of pump control. The transmitter (left) usually consists of a synchronous motor-driven cam and a cam follower arm which is positioned by the primary pressure element. When the follower arm is on the cam, an electric contact is made, transmitting a signal of a duration directly proportional to the pressure. At the receiving end (right), a pair of synchronous motor-driven magnetic clutches are alternately energized by the time-impulse signal to position the receiving element, which in turn controls the pumps.

receiver in the pump room, a pair of synchronous motor-driven magnetic clutches are alternately energized by the time-impulse signal to position the receiving element, thus exactly duplicating the position of the primary element at the transmitter. This system is not affected by normal variations in line voltage, resistance or inductance. Synchronization is provided to permit the resumption of operations after a power failure or circuit interruption.

quency is available at both ends. Numerous devices are available for this service, employing resistance, voltage, current or duration impulses.

Special adaptations permit transmission of other functions over the same pair of wires. Thus, the control function may be combined with information on flows, temperatures, and other line conditions. Two methods may be used for multiple transmission over a two-wire circuit: simultaneous

transmission, in which all functions are sent at the same time, and sequencing transmission (2), in which only one function may be transmitted at a time, the several functions following each other in rapid succession.

If leased wire circuits are used, rental is charged by the telephone company for each circuit mile. In simultaneous transmission, the charge is based on the number of functions transmitted multiplied by the circuit length in miles. The sequence method affords substantial savings as only one function is transmitted at a time and the only variable factor is distance.

At the receiving end, the controls consist of adjustable switches set to govern the pumps as desired. Glass-enclosed mercury switches afford less difficulty in operation than open contacts.

Suitable relays may be interposed to keep high voltages out of the control circuit or to control power in excess of switch ratings. Three-position—"Hand," "Off," and "Automatic"—switches may be used to transfer control for testing or manual operations. Visual and auditory alarms are available to notify the operator of abnormal conditions. Frequently a "watchman" circuit will be employed to advise the operator of power failure at the transmitter, or of open or short-circuited lines.

Time Cycle Control

As the name denotes, time cycle control is that method of control which starts a pump or pumps in response to a predetermined time relationship which may be adjusted for seasonal or weekly variations. Usually, some form of simple pressure control must be used with time cycle control to provide for unusual conditions, such as low suction head or excessive fire flows. When used in conjunction with the pressure-flow system, a cam may be installed to adjust pressure ranges for different periods of the day or week.

Remotely Supervised Control

It is sometimes desirable to retain manual control of the operation of pumping equipment or other devices from some remote station. The apparatus which makes provision for such control is known as the "supervisory control" system and is frequently used in the control of raw water or deep well pumps located some distance from a filter plant, main pumping station or reservoir. The control center or dispatcher station used in this system is usually installed in some convenient place, such as the filter plant, main pumping station or superintendent's office. Field substations are provided in each pumphouse. If the several units are close to each other, a single, central field control station may be used. One or more of the following operating results may be obtained, depending on particular system requirements:

1. The starting and stopping of pumps
2. Reports of the operating condition of the device
3. Signals of faulty or interrupted operation
4. The telemetering of additional information on pressures, flows, temperatures or other factors.

Various methods are used to accomplish the control functions. The simpler systems employ a type of positioning or stepping relay in which the dispatcher rotates a knob or dial to the desired function and the field station,

assuming a corresponding position, performs the control function.

Other systems employ coded impulses similar to those used in the dial telephone system. Impulses may be unidirectional currents of the same or opposing polarities. One such system employs a dial for the dispatcher station; others use push button stations or toggle action switches to perform the following operations in the sequence indicated:

1. Selecting of remote control unit
2. Starting or stopping of field unit or other control of its operation
3. Reporting that the operation has been carried out
4. Resetting equipment for the next operation.

Control functions of this type are performed in sequence with great rapidity. The equipment may be mounted on a panel together with other instruments which provide the operator with auxiliary information on pressures, flows, temperatures, water levels or other factors. The units may be operated directly or telemetered; if the latter, they may use the same wires as the control circuit or separate circuits. Auxiliary devices include watchman circuits which warn of line faults, line testing equipment, telephone communication and storage battery and charging equipment for emergency operations. Such systems readily pay for themselves through the savings they make possible in freeing personnel for other duties but they do require adequate technical personnel for servicing.

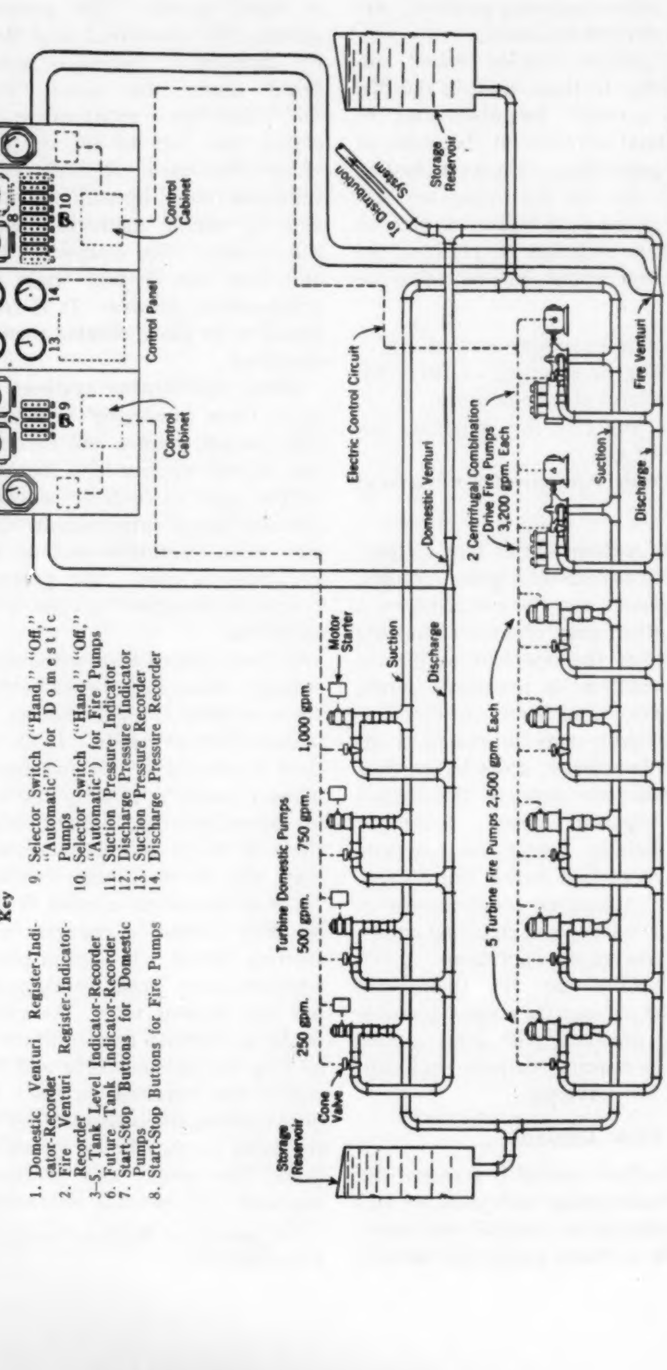
Pressure-Flow Control

Pressure-flow control is a recent development combining both pressure and flow information to control the operation of one or more pumps of variable or fixed speeds. The pressure-flow system (3) conceived and developed by Marsden C. Smith is being marketed under the name "Pressureflo" * and has a wider range of application than any of the controls previously discussed. Reliable control and fully automatic operation, not obtainable by simple methods, characterize this system. The equipment is sturdy and does not depend upon external transmission circuits. It is frequently found to be more reliable than manual operation.

Many distribution systems, particularly those involving outlying areas with booster pumps and elevated storage, do not readily lend themselves to simple types of control because of line friction, large intermediate draw-offs and other conditions such as extreme variations in flow. The pressure-flow system is designed to cope with such problems.

At low rates of flow, without elevated storage, there may be sufficient pressure available from the source to meet booster district needs. If an elevated tank is used, the only function of the booster pump is to keep the tank full for emergency use. Under such conditions, it would be uneconomical to operate the booster pump continuously. As flow increases, contact is made by the flow meter to energize a pump-starting circuit. If suction pressure is adequate, and "area" pressure falls below the desired value, the pump will begin to operate and continue to run as long as both pressure and flow are within the required ranges. If additional pumps are available, they too may be placed on the line by means of additional flow meter and pressure zone contacts. To provide extremely close

* A product of Builders-Providence, Inc., Providence, R.I.



Courtesy G. W. Coffin, Coffin & Richardson, Inc.

Fig. 2. Typical Application of "Pressureflo" Control

The venturi recorder selects the proper relay circuit to actuate the desired pump.

control, the pumps should be variable speed or a combination of fixed and variable speeds. When the pumps are no longer required, flow and pressure contacts are opened to stop their operation. Figures 2 and 3 show the characteristics of a typical pressure control system used with elevated storage tanks.

Pressure-flow control units can be adapted to existing stations or to new pump stations without raising special structural problems. Provision must be made for metering the flow and for determining the pressure or level. Although a single meter can be used for one or more pumps, several meters may be provided on individual pump discharges, with the flows added for control purposes. Some form of initiating control is usually employed; this may consist of a low pressure switch on the discharge line or a minimum level contact in a reservoir or tank level gage.

Once a pump has been started, it will continue to run as long as the flow remains above the predetermined minimum or the pressure remains below the set maximum. The system may be used for single or multiple pumps of either fixed or variable speeds. Pressure-flow control is particularly well suited to use in a direct pressure system such as is frequently encountered in tall buildings and airports. Such a system has been designed for the Logan International Airport of Boston by Coffin (4).

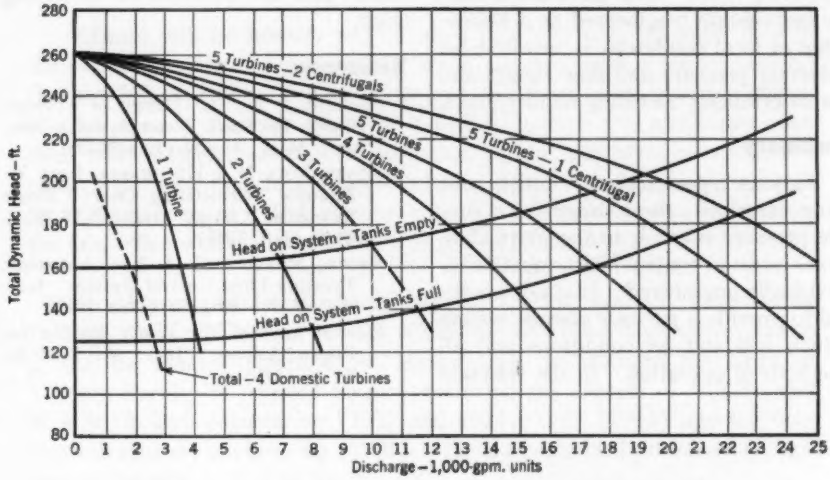


Fig. 3. Head-Capacity Curves for "Pressureflo" Control

The curves show the head-capacity relationships for the "Pressureflo" control system illustrated in Fig. 2.

The system can function equally well with ground level storage, elevated tanks or standpipes. Although permitting the most economical and efficient operation, it nevertheless provides for instantaneous handling of peak re-

quirements. Economy is made possible by smaller storage tank requirements as the portion required for emergency operation on conventional installations may be eliminated. Pressure-flow control also permits a wider area of choice in the location of elevated storage sites, either to effect economies or to overcome objections by property owners. Frequently, ground level storage may be substituted for elevated storage at a substantial saving in initial and operating costs. Each installation must be individually engineered as a knowledge of local conditions is required for selecting pressure and flow ranges and for determining operating requirements.

Summary

Various types of pump control have been described; these range from simple pressure controls to the more elaborate forms of control which must be individually engineered. It is not practical to provide a *package* control system which will suit all conditions and all methods of operation. In the selection of controls, simplicity, sturdiness, reliability and flexibility must be considered. Often emergency operation depends upon controls of this type. During periods of great demand, such as are afforded by firefighting, for example, there can be no compromise with speed of adjustment and reliability. Perhaps of greatest importance, properly engineered controls permit substantial savings in operating costs, a point of vital interest to management faced with the problem of increasing costs.

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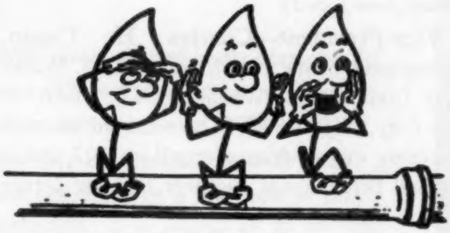

Percolation and Runoff

Miami will be history to you when you read this, but right now in the painful process of preparing for it we can only wish it were—history, that is—Miami, that is! What we resent, of course, is the fact that everyone has already told you all about it and here come we, worse late than ever, still completely dumb. What's more, what with what is now ahead of us, we're unwilling to predict, much less guarantee, that there ever will be a Miami meeting. But when you read this, if will be was, these were the new officers officially installed just before it was over:

President—Albert E. Berry, director of the Sanitary Engineering Division, Ontario Dept. of Health, Toronto, Ont. (See frontispiece, facing p. 327, for photo.) Born at St. Marys, Ont., he attended the Univ. of Toronto Faculty of Applied Science, receiving the degrees of B.A.Sc. and M.A.Sc. in civil engineering (1917 and 1921), C.E. (1923) and the doctorate in sanitary engineering (1926). He is a registered professional engineer in Ontario.

In addition to serving with the Ontario Dept. of Health, which he joined as sanitary engineer in 1919, he has been associate professor at the School of Hygiene of the Univ. of Toronto and during World War I served in the Royal (Imperial) Engineers.

He has been secretary-treasurer of the Canadian Section since 1933, with an interval from 1937 to 1940 when he was its director. Association activities include membership on the publication committee and the committee on joint administration of water and sewer facilities; and the chairmanship of the Water Purification Div. (1935–36) and the Fuller Award society, which he joined upon receiving the Canadian Section's award in 1938. He has also been vice-president of the American Public Health Assn. and president of the Federation of Sewage Works Assns., has been secretary-treasurer of the Canadian Inst. on Sewage and Sanitation since 1933, was a member of the Board of Technical Advisers of the Boundary Water Survey and is now a member of the Royal Canadian Institute.

(Continued on page 2)

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Vice-President—Charles H. Capen, chief engineer of the North Jersey Dist. Water Supply Commission, Wanaque, N.J. Born in Jersey City, N.J., in 1895, he received his civil engineering degree from Cornell in 1917 and is a licensed professional engineer in New Jersey and New York.

In the latter year he joined N. N. Chester Engineers, Pittsburgh, as resident engineer.

After working for consulting engineers for two years he joined the New Jersey Dept. of Health in 1925 as assistant sanitary engineer. Six years later he joined the staff of the North Jersey organization as assistant engineer, advancing to his present post with but a brief interruption for military service during World War II, when he was chief sanitary engineer for the Second Corps area. He is also actively engaged in consulting work.

A member of A.W.W.A. since 1930, he has been chairman of the Publication Committee, the Goodell Prize Committee and the Fuller Award Society, having received his section's Fuller Award in 1938. He has also been active in a number of other Association committees and, in addition, was chairman of a New Jersey Section legislative committee which sponsored and helped obtain licensing and tenure legislation, was a member of the governor's Engineering Committee reporting in 1938 on the state's water supply, and participated in a number of other advisory and technical committees.

Treasurer—William W. Brush, editor of *Water Works Engineering.* Brush was born in Orange, N.J., in 1874 and was educated at New York Univ., from which he received B.S., C.E., and M.S. degrees. He joined the staff of the then Brooklyn Water Dept. in 1894, transferring to the New York Board of Water Supply in 1907, in the capacity of engineer. He was appointed chief engineer in 1927, and retired in 1934 after a cumulative total with the two organizations of 40 years of service. Nothing daunted, he promptly accepted the post of editor of *Water Works Engineering,* which he has held ever since.

A member of A.W.W.A. since 1911 and an Honorary Member since 1937, Brush has been an officer of the Association continuously since 1922, when he was first elected Treasurer.

(Continued on page 4)

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The accident rate at any water works is rarely accidental. Among the educational tools available to keep the record a good one are several new booklets distributed by the National Safety Council, 425 N. Michigan Ave., Chicago 11, Ill. "Aren't People Funny?" presents a humorous treatment of the unfunny subject of a dozen accident-inviting human attitudes. "K.O. Dirt and Disorder" applies the same approach to the hazards of poor plant housekeeping. And "Cry Whoa!" applies Shakespeare to motor vehicle casualties. Sample copies and quantity quotations are available from the council on request.

An additional approach to keeping down the motor vehicle accident rate is furnished by The Travelers Insurance Cos., Hartford, Conn., which is distributing free of charge a booklet—also serio-comic—on accident statistics entitled "R.I.P." (Rest in Pieces). Also furnished by The Travelers is a list of matter-of-fact statements, some of which would bear posting in utility garages:

Three out of four traffic accidents happen in clear weather on dry roads.

More than 80 per cent of all accidents last year on our streets and highways involved vehicles going straight.

An overwhelming majority of motor vehicles involved in accidents last year were reported in apparently good condition.

Ninety-eight per cent of drivers involved in fatal automobile accidents in the U.S. last year had at least one year's driving experience.

Last year, 35,500 Americans were killed in traffic accidents.

In 1950, 1,799,800 Americans were injured in traffic accidents.

There were 235,800 more persons injured in U.S. motor vehicle accidents last year than in 1949.

One out of every three Americans who lost their lives in last year's wrecks died because someone was driving too fast.

Almost 500,000 casualties in 1950 were the direct result of speeding.

The booklets are sure to be looked at; they are very funny. The record needs desperately to be looked at; it's just the reverse.

Fifty years ago in Washington, D.C., of all places, water consumers often got something for nothing—food, that is—fish food. That's the major remembrance of Charlie Bawsel from the old days when he started with the District Water Division. Quitting now after a half-century of service, Charlie found his recent work in the pumping station less exciting than when fish used to tangle with the pumps. That may be why he quit.

(*Continued on page 6*)

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Rainmaking ain't what it used to be. Not so long ago we felt like a pioneer when we put tongue in cheek and went speculating through the potentialities of seeding the clouds. Now, with our predictions so soon realized in the form of cloud ownership squabbles, synthetic storm damage suits and statutory controls, we're almost more frightened than satisfied. Last thing we heard, things were entirely serious—the country club publicity type of suit had given way to honest-to-goodness damage claims by property owners who had nothing to gain but money; the irrigationists out west had organized a National Weather Improvement Association to promote the use and development of *scientific* cloud seeding; the state of Colorado had passed "an act to assist and foster private or public research and development in artificial weather modification, and to protect life, property and public interest from injurious weather modification practices"; and Sen. Clinton P. Anderson (D., N.M.) was studying Senate bills 3, 222 and 798 to bring rainmaking under federal control—a step supported just the other day by none less than Dr. Vannevar Bush, wartime head of the nation's scientists.

What with rainmaking scientifically acceptable to all but the weathermen (who apparently don't know a good alibi when they see one), we're ready now to pick up our dry-ice cubes and go home.

(*Continued on page 8*)

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"Just Add Water"—our February feature (P&R, p. 6) on the concentrates—apparently didn't delve deeply enough into the powers of concentration. In the New York City area, for instance, the "threat" of the "revolutionary" milk concentrate had no more than been mentioned before milkmen began a frantic stringpulling to get the concentrated cow juice classified as "fluid" rather than "manufactured" milk—enabling them to hold the savings to consumers down to a mere penny a quart and keep the real moola closer to the moo—all of which should prove that even the dairies don't make their fortunes on water.

"Just Add Water," in Canada, on the other hand, seems to be an invitation to get soaked. At any rate, when a Montreal manufacturer put a "Prune Nectar" on the market, he found it subjected to an excise tax on the basis that the product was not a "pure juice of the fruit," but one containing "a certain amount of added water," picked up in the stewing. Not to be too harsh with the polluting agent, the Board of Trade, in reviewing the tariff board ruling, pointed out that the water did not make the "Nectar" "imitation prune juice" as claimed, but "a water extract of dried prunes . . . in popular parlance, prune juice." That didn't remove the tax, however, merely clarifying its status as an excise levy on water.

Now if water is thus to be taxed, we rather prefer the Dutch method, in effect since last January 1, whereby a luxury tax of 15 per cent is placed on all water used in boilers and hot-water heaters having a capacity of eight gallons or more. It's that word "luxury" we like, for what could be more luxurious than a shower or a bath on a hot summer day, and what's a shower or a bath without water?

Panacean though it may be in the food business, "Just Add Water" just doesn't seem to be wanted in government, which has its own: "Just Add Taxes."

Dearborn Chemical Co. has moved to new and larger quarters at Merchandise Mart Plaza, Chicago 54, Ill.

(Continued on page 10)

—it's protected by
BITUMASTIC
70-B ENAMEL

● The 36-inch steel pipe pictured here is part of a new water line being laid for a well-known midwest water works. This new pipe line is about 6,000 feet in length and is protected, inside and out, by Bitumastic® 70-B Enamel.

Inside the pipe, a glass-smooth lining of Bitumastic 70-B Enamel prevents rust, corrosion and tuberculation. This spun lining of durable enamel will *keep* flow capacity high, thus reducing pumping costs. And, with this kind of protection, there's no need to spend money for *oversized* pipe in order to allow for future "shrinkage."

On the outside of the pipe, Bitumastic 70-B Enamel prevents pitting and leakage caused by soil corrosion. Here, again, you save money by keeping maintenance and replacement costs low. In every way, it pays to protect *your* community's large-diameter pipe lines *inside* and *out* with Bitumastic Enamels.

KOPPERS BITUMASTIC ENAMELS

REG. U.S. PAT. OFF.

KOPPERS COMPANY, INC., Tar Products Division, Dept. 505T, Pittsburgh 19, Pa.

(Continued from page 8)

Harry P. Croft, who retired on January 1 as chief of the Bureau of Public Health Engineering, New Jersey Health Dept., died at his home in Trenton on March 27. He was 60 years old, and at his retirement had completed 38 years of service for the state, all but the first five in the same capacity.

The Supreme Court has handed down its decision in the Ohio River Valley Water Sanitation Commission case (*see* November 1950 P&R, p. 14), and the result is a resounding victory for the commission and proponents of West Virginia's participation in the compact. The court was unanimous in reversing the ruling of the West Virginia Supreme Court that the state's constitution was violated by the legislature in joining the compact and delegating some of its police powers to the commission. The decision, which was written by Justice Felix Frankfurter, held, in part, that the compact involved only a "conventional grant of legislative power." The opinion continued:

> We find nothing in that to indicate that West Virginia may not solve a problem such as control of river pollution by compact and by the delegation, if such it be, necessary to effectuate such solution by compact. . . .
>
> The compact involves a reasonable and carefully limited delegation of power to an interstate agency.

Justice Robert H. Jackson, concurring, added that the state could not now "read herself out" of her contractual obligation under the compact. A further opinion was voiced by Justice Stanley Reed, who, although concurring with the decision, held that the court had no power to interpret the state constitution.

Regardless of detail, the decision appears to be a clear-cut defeat for State Auditor Edgar B. Sims, who had refused to pay the state's share of the commission's operating costs. It should also be of the widest importance in laying a stable legal footing for future antipollutional interstate compacts because it affords legal recognition to the fact that river basin problems cannot be handled by local geographic units, except through participation in wider organizations which they may establish for the purpose.

Grant A. Colton has been elected president of Golden-Anderson Valve Specialty Co. He was previously vice president and general manager of the company.

L. W. Grayson, general manager and chief engineer of the Electric Light and Water Depts., Dept. of Public Utilities, Riverside, Calif., has resigned after a 25-year association with the city to become general manager and chief engineer of the Public Service Dept., Glendale, Calif.

(Continued on page 12)

(Continued from page 10)

Civilian defense in the water supply field turned up a couple of stories worth mentioning last month. One was the appeal sent out by the Glen Ridge, N.J., water department asking its public to report all wells, springs or other sources of water potentially useful as auxiliary supplies in the event of emergency. Meanwhile, the D. E. Foote & Co. cannery down in Baltimore went at the problem in another way, filling from 75,000 to 100,000 10½-oz. reservoirs per day not strictly for the military, as during World War II, but for the civilian defense stockpile as well.

What price water anytime?

Underground storage of natural gas, contemplated by gas pipeline companies to equalize the seasonal pumping load, has evoked concern in New Jersey, where the State Division of Water Policy and Supply has suggested that such storage in underground cavities might contaminate ground water. A bill has been introduced by the assembly's majority leader to ban the storage, test borings for which have been conducted in the pines section of Burlington County, and agreement has been reached to hold a hearing on the matter.

(Continued on page 14)

(*Continued from page 12*)

The spread of fluoridation has now reached public water supplies in West Virginia, where Wheeling and Weirton are practicing this method of caries control and Wellsburg and Ripley have recently received permits to do so from the State Health Dept.

The children's hour apparently is at hand. At any rate, the present hurry about fluoridation is primarily aimed at catching the current crop of children while they're young enough to obtain maximum benefits. All over the country the subject is being discussed—Seattle is considering treatment; New Rochelle, N.Y., recently adopted it; the New York State Health Dept. has approved the treatment; in Missouri, in Texas and everywhere dental societies are getting on the bandwagon of community action.

That's the children's hour, but leave it to the U.S. Public Health Service to keep everybody happy with a caries cure for adults too. Chew tobacco, say they. Whether it's the chewing or the tobacco that counts they haven't discovered yet. But chew tobacco. As for us, we'll take cavities!

Karl R. Kennison, consulting civil and hydraulic engineer, has been appointed lecturer in civil and sanitary engineering at Massachusetts Inst. of Technology. He was formerly chief engineer of the construction division of the Metropolitan (Boston) District Commission.

A new flow interlock will operate to open an electrical contact when a flow of water exceeds a set rate, and close it again when the flow drops. It can be used to operate pump or other controls and can be set to regulate flows from 0.5 to 4 gpm., with a 0.1 gpm. differential between cut-in and cut-out. Applications include cooling water and laboratory flows. Further details may be obtained from the Control Div. of General Electric, Schenectady 5, N.Y.

A new distillation unit for military water supplies is under development at the Engineering Research and Development Labs., Fort Belvoir, Va. The novel feature of the equipment, an electric-powered thermocompression unit, is its designed ability to be run for 3,000 hours without interruption for scale removal. A contact stabilizer filled with sand or limestone was developed through research at the Univ. of California and, by offering greater contact surface to circulating evaporator brine, is said to reduce evaporator tube scale formation by 95 per cent. The original fuel–production ratio of 1 : 250 (by weight) is still being maintained in one 1,250 gph. unit which is being service tested (Alas! Poor Kenneth Roberts and his neglected, long-distance-dowsed, inexhaustible water domes!) on Bermuda.

(*Continued on page 16*)

(*Continued from page 14*)

A measuring wheel designed to permit quick determination of distances is being offered by Rolatape Inc., Santa Monica, Calif. Measurements are obtained by rolling a wheel exactly 4 ft. in circumference over the course and observing the built-in counter. Straight and curved or angular distances can be measured without loss of accuracy, according to the makers, who suggest its use for locating paving cuts, measuring main extensions and general estimating work. For obvious, if unimaginative reasons, the Rolatape people don't own up to it, but the dictionary calls their gadget a *perambulator*.

If your mail arrives more promptly from now on you'll know why. The safety director in the office of the Postmaster General recently requested copies of Willing Water's "Rx for Meter Readers," explaining that "the problems of the letter carrier and meter reader are not dissimilar from the viewpoint of their exposure to dog bites." Being only too glad to do our bit to speed the mails, we, of course, complied and are certain that now it will be only a matter of time before our own mailman stops wearing his cast-iron socks and speeds up his pace.

(*Continued on page 18*)

(Continued from page 16)

Abstracts of nearly all articles on corrosion published in 1946 and 1947 are contained in a book just announced by the National Assn. of Corrosion Engineers and entitled *Bibliographic Survey of Corrosion—1946–1947.* The volume is a successor to the 1945 compilation and sells for $9; both volumes may be obtained for $12. The abstracts are arranged according to the N.A.C.E. filing system index and author and subject indexes are included.

Also being furnished by N.A.C.E. are individual abstracts on McBee punch cards, coded to permit rapid manual sorting. The punch card system is available on a subscription basis, at an annual cost of $75. Additional information may be obtained from N.A.C.E. at 919 Milam Bldg., Houston 2, Tex.

The 1951 Gordon Research Conference on Ion Exchange, sponsored by the American Assn. for the Advancement of Science, will be held from June 18 to August 31 at the New Hampton School, New Hampton, N.H. Further information may be obtained from W. George Parks, Director, Dept. of Chemistry, Univ. of Rhode Island, Kingston, R.I.

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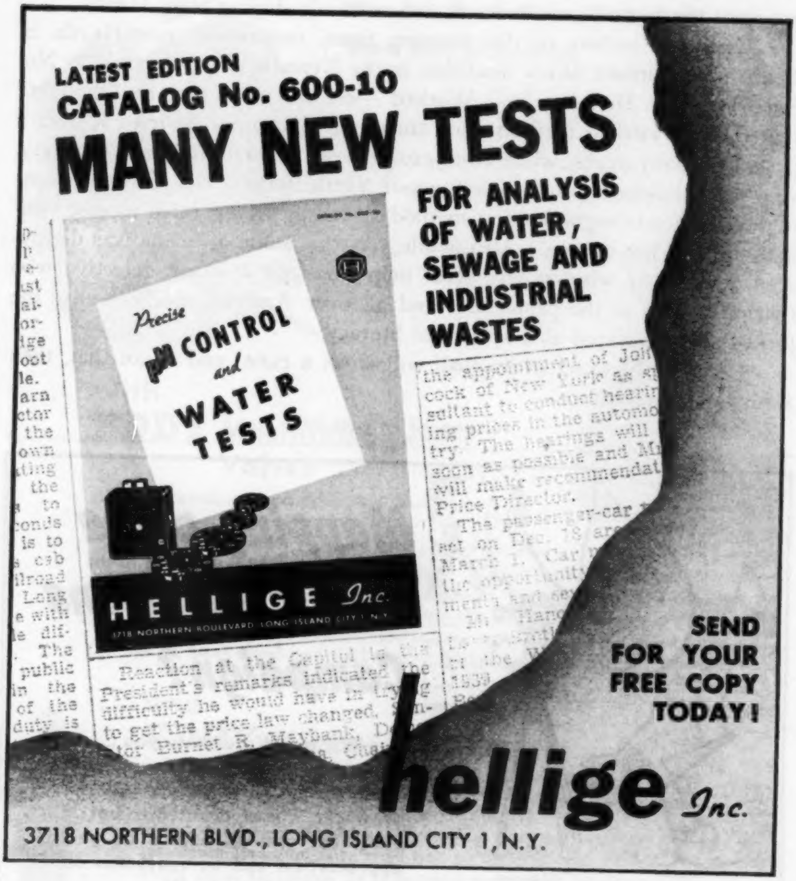
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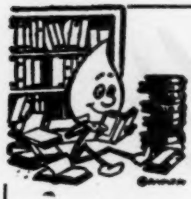
(Continued from page 18)

Television, which introduced water to videots in grand style just a month ago via Abel Wolman and the Johns Hopkins program on Baltimore's WAAM, undid itself again this month when it screened "Henry Gross and his dowsing rod in an actual demonstration of the amazing powers of a water dowser." To say that the demonstration was all wet would be giving Henry too much credit; anyway, Faye Emerson, on whose program the fantasy was enacted, was certainly diviner than Henry.

On other sectors of the dowsing front, meanwhile, one Haydn S. Pearson got himself heavy headlines in the Newark, N.J., *News*—"Is Not Sure Whether Divining Rod Worked"—on the basis that he "thought" that the rod worked for him once out of the 500 times he tried it over a period of many years, while two Jesuit priests from Fordham University, who were shaking up the whole town of North Bergen, N.J., with attempts to develop a seismographic test method of finding water, rated a puny two-inch filler all but unseen. Meanwhile, too, the Stone of Scone was discovered, apparently without any great help from the dowsing detective who twirled a twig at the problem. And all over America, undoubtedly, the forked stick appeared as a symbol of literacy.

Perhaps the onset of baseball will effect a cure; and if not that, then assuredly MacArthur.

(Continued on page 94)



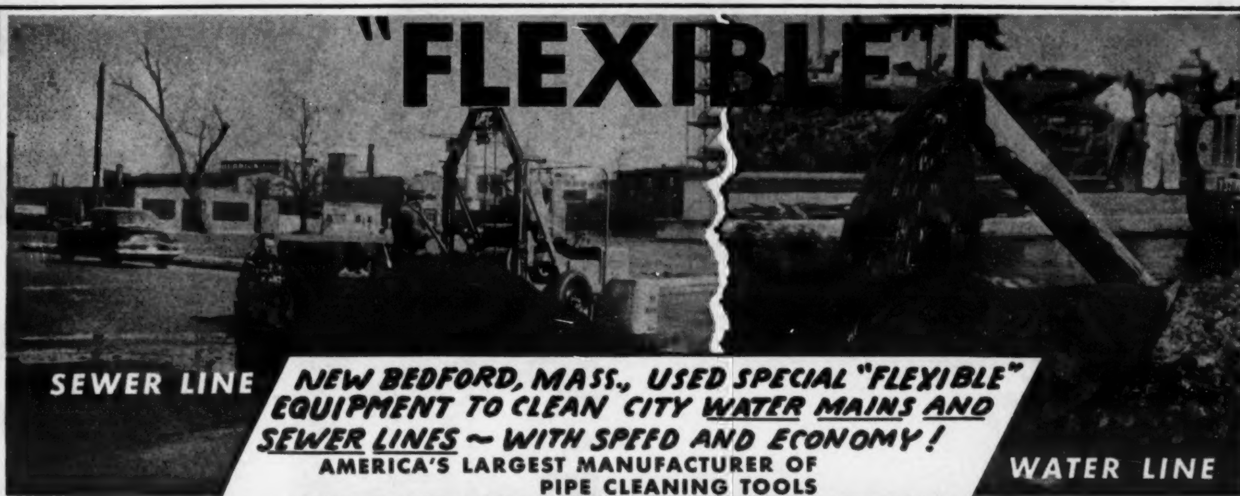
The Reading Meter

A Water Policy for the American People. Vol. 1—General Report *(1950; $3.25)*; **Vol. 2—Ten Rivers in America's Future** *(1950; $6.00)*; **Vol. 3—Water Resources Law** *(1950; $2.25)*; **Summary of Recommendations** *(1950; 15¢). President's Water Resources Policy Commission. U.S. Government Printing Office, Washington 25, D.C.*

With publication of the last of these volumes, the President's Water Resources Policy Commission has completed its task. Appointed in January 1950 to study water resources policies and existing legislation and to make recommendations, the commission, under the chairmanship of Morris L. Cooke, has produced over 2,000 pages of reports in three massive tomes. The first volume contains the body of the report itself—"a water policy for the American people"—and the summary of recommendations which have also been printed in a separate booklet, as well as being reprinted in the February 1951 JOURNAL (Vol. 43, p. 91). Volume 2, a study of the Columbia, Missouri, Rio Grande, Colorado, Connecticut, Alabama-Coosa, Potomac, Ohio and Tennessee Rivers and the California Central Valley, has also been published in separate sections. Federal water resources law is the subject of the third volume, which is really a byproduct of the investigation. An appendix summarizes the water-law doctrines of the seventeen western states.

Water Treatment for Industrial and Other Uses. *Eskel Nordell. Reinhold Pub. Corp., New York (1951) $10*

A clear and simple presentation of the basic principles and specific practices of water treatment for industry is offered by this volume. Chapters containing essential background as well as working information cover such topics as dissolved solids and gases, turbidity and organic matter, selection of treatment process and equipment, boiler feedwater, cooling water and various types of treatment, including ion exchange and softening. An appendix contains a number of useful tables of equivalents and other data of value.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Membership Changes

NEW MEMBERS

Applications received March 1 to 31, 1951

Ahern, P. C., Cons. Engr., Maritime Eng. Consultants, C.P.R. Bldg., Halifax, N.S. (Jan. '51)

Aitkin Light & Water Com., G. N. Blount, Mgr., Aitkin, Minn. (Corp. M. Jan .'51)

Albright, Philip N., *see* San Antonio (Tex.) City Health Dept.

Alexander, M. H., Water & Sewer Supt., 112 W. League, Monahans, Tex. (Jan. '51)

Anderson, Paul W., Water & Sewage Supt., Plattsburg, Mo. (Jan. '51) *MPR*

Armstrong, George Kent., City Engr., Box 803, Dunedin C. 1., New Zealand (Jan. '51) *MP*

Balendonck, William A., Salesman, Neptune Meter Co., 2630 Texas Dr., Dallas, Tex. (Jan. '51) *M*

Bartlett, Dan Tommy, Sanitarian, Jasper-Newton Health Unit, 956 E. Milan, Jasper, Tex. (Jan. '51) *P*

Bauman, Eugene O., Chief Inspector, Dept. of Water Supply, Gas & Elec., 2420 Municipal Bldg., New York 7, N.Y. (Jan. '51)

Baxter, Richard M., Partner, Baxter & Woodman, Civ. & San. Engrs., Box 67, Crystal Lake, Ill. (Jan. '51) *PR*

Becker, Robert J., Plant Engr., Purification Dept., Indianapolis Water Co., 113 Monument Circle, Indianapolis, Ind. (Jan. '51) *P*

Bendler, Arthur F., *see* Holdrege (Neb.)

Benning, Walter J., Jr., Sales Repr., Johns-Manville Sales Corp., Albuquerque, N.M. (Jan. '51)

Biles, Ray, Utility Supt., Box 248, Sunray, Tex. (Jan. '51) *M*

Bishop, William J., Health Officer, Health Dept., Bartlesville, Okla. (Jan. '51) *P*

Black, John L., Water & Sewage Supt., Box 374, Refugio, Tex. (Jan. '51) *MP*

Black, William L., Water Supply Supt., Dept. of Water & Sewers, Box 316 Coconut Grove Station, Miami 33, Fla. (Jan. '51) *MPR*

Blount, G. N., *see* Aitkin (Minn.) Light & Water Com.

Bourne, William H., Civ. Engr., Dept. of Water & Sewers, Box 316 Coconut Grove Station, Miami 33, Fla. (Jan. '51) *M*

Brownhill, Harold E., Mgr.-Engr., Public Utilities Com., 153—6th Ave., Cochrane, Ont. (Jan. '51)

Campbell, J. Packard, Mgr., James Robertson Co., Ltd., 1-19 Broadview Ave., St. John, N.B. (Jan. '51)

Capehart, James P., Alta Mesa Corp. Water Works, 301 S. Winnetka, Dallas, Tex. (Jan. '51) *M*

Carleton, William Arthur, Mgr., Welded Pipe & Tank Sales, O'Neall Div., Armco Drainage & Metal Products, Inc., 3202 W. Sample St., South Bend, Ind. (Jan. '51) *R*

Carroll, William J., Civ. Engr., J. M. Montgomery, Cons. Engr., 15 N. Oakland, Pasadena, Calif. (Jan. '51)

Carter, J. S., *see* Chatham (Va.)

Castella, Cesar, *see* Fomento de Bauta, Cia.

Casto, Dwight Earl, Sr., Utilities Supervisor, Carbide & Carbon Chem. Div., Texas City, Tex. (Jan. '51) *MP*

Chatham, Town of, J. S. Carter, Director of Public Works, Chatham, Va. (Mun. Sv. Sub. Jan. '51) *MP*

Chisholm Water & Light Com., H. S. Hanson, Supt., Chisholm, Minn. (Corp. M. Jan. '51) *MPR*

Clement, Albert E., *see* Natrona (Pa.) Water Co.

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Cocoa, City of, Jerry Sellers, Plant Operator, Box 1228, Cocoa, Fla. (Corp. M. Jan. '51) *MPR*

Colby, George W., Sr. Civ. Engr., Constr. Inspection Section, East Bay Munic. Utility Dist., 512—16th St., Oakland, Calif. (Jan. '51) *M*

Colonial Terrace Inc., C. S. McLeod, Secy., 210 Masonic Temple Bldg., Jacksonville, Fla. (Corp. M. Jan. '51) *MPR*

Columbia Water & Light Dept., George H. Rendleman, Director, Munic. Bldg., Columbia, Mo. (Corp. M. Jan. '51) *M*

Copp, Stanley S., Sr. San. Engr., Public Health Eng. Div., Dept. of National Health & Welfare, 406 Post Office Bldg., Edmonton, Alta. (Jan. '51)

Cushing, City of, J. B. Davidson, City Engr., City Hall, Cushing, Okla. (Corp. M. Jan. '51) *M*

Davidson, J. B., *see* Cushing (Okla.)

Davin, Joseph W., *see* Stockton, Whatley, Davin & Co.

Davis, Stephen Howell, Asst. to Gen. Mgr., Munic. Authority of the City of New Kensington, Box 592, New Kensington, Pa. (Jan. '51) *M*

Dennis, John F., City Engr., Laurel, Mont. (Jan. '51)

Dix, Thurman W., Comr. of Public Works, 40 Beacon St., Barre, Vt. (Jan. '51)

Doane, H. W. L., Mgr., Standard Paving Maritime, Ltd., Box 1083, Halifax, N.S. (Jan. '51)

Dougherty, A. E., *see* St. Stephen (N.B.) Water Comrs.

Downes, Louis R., Sales Engr., Neptune Meter Co., 4048 W. Taylor St., Chicago, Ill. (Jan. '51)

Drummond, Kent G., Graduate Student, San. Eng., Univ. of Iowa, Iowa City, Iowa (Jr. M. Jan. '51)

Duvall, R. J., *see* Kansas City (Kan.) Board of Public Utilities

Economics Lab., Inc., John L. Wilson, Director, Research & Development Div., 914 Guardian Bldg., St. Paul 1, Minn. (Corp. M. Jan. '51) *P*

Eggett, Matthew, Asst. Exec. Officer, Regional Water Pollution Control Board No. 4, 541 S. Spring St., Los Angeles 13, Calif. (Jan. '51) *PR*

Elenz, Edward F., Sales Engr., Wallace & Tiernan Co., Inc., 1229 W. Washington Blvd., Chicago, Ill. (Jan. '51) *P*

Fayetteville, City of, A. J. Simmons, Munic. Bldg., East College St., Fayetteville, Tenn. (Corp. M. Jan. '51)

Fellows, Fred G., Cons. Engr., 1017½ W. Highland, Ponca City, Okla. (Jan. '51) *R*

Finster, Edwin H., San Engr., Orange County Health Dept., Court House Annex, Santa Ana, Calif. (Jan. '51) *P*

Fomento de Bauta, Cia, Cesar Castella, Pres., 361 Aguiar St., Havana, Cuba (Corp. M. Jan. '51) *MR*

Fort Branch Water Works, Rollin Redman, Supt., Box 3, Fort Branch, Ind. (Corp. M. Jan. '51)

Francis, Lee A., San Eng. Asst., Dept. of Water & Power, 207 S. Broadway, Los Angeles 12, Calif. (Jan. '51) *MR*

Frigon, Rosario, Assoc., Papineau & Frigon, 212 St-Sacrement, Montreal, Que. (Jan. '51)

Froehde, Fred C., *see* Pomona Valley (Calif.) Munic. Water Dist.

Fruitman, Harold Leon, Sr. Water Chemist, San Francisco Water Dept., Purif. Div. Lab., Millbrae, Calif. (Jan. '51) *P*

Funk, Geraldine E. (Miss), Asst. in Research, San. Research Lab., Civ. Eng. Dept., Univ. of Florida, Gainesville, Fla. (Jr. M. Jan. '51) *PR*

Gannon, Dan R., Supervisor Water Meter Sales, Rockwell Mfg. Co., 122 S. Michigan Ave., Chicago, Ill. (Jan. '51)

Garcia, Luis E., Asst. Director, Water Supply Dept., Box 405, Quito, Ecuador (Jan. '51)

Gish, Roy R., Cons. Engr., Couch & Kulin, Inc., 230 E. Ohio, Indianapolis, Ind. (Jan. '51) *PR*

Great Barrington Fire Dist., John P. Tracy, Chief, Great Barrington, Mass. (Corp. M. Jan. '51) *MPR*

Green, Richard C., Vice-Pres., Missouri Public Service Co., Warrensburg, Mo. (Jan. '51)

Hanson, H. S., *see* Chisholm (Minn.) Water & Light Com.

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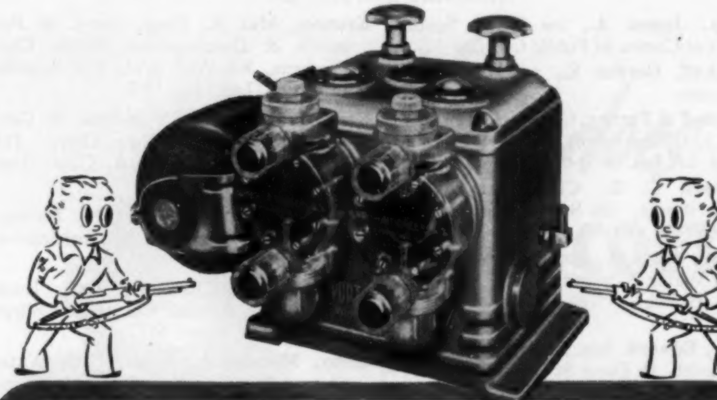


(*Continued from page 32*)

Hanway, James A., *see* Nova Scotia Board of Comrs. of Public Utilities

Herkenhoff, Gordon E., *see* Herkenhoff & Turney

Herkenhoff & Turney, Gordon E. Herkenhoff, 223 Montezuma, Santa Fe, N.M. (Corp. M. Jan. '51)

Hesselbart, C. B., Chief Clerk, City Water Works, 166 S. High St., Akron 8, Ohio (Jan. '51)

Holdrege, City of, Arthur F. Bendler, Light Water & Sewer Comr., 502 East Ave., Holdrege, Neb. (Corp. M. Jan. '51)

Howard, Edward, San. Engr., State Dept. of Health, 16 Dietz St., Oneonta, N.Y. (Jan. '51)

Howe, Lois M. (Miss), Chemist, State Dept. of Public Health, 1800 W. Fillmore St., Chicago, Ill. (Jan. '51)

Howell, Weldon Young, City Engr., Trenton, Tenn. (Jan. '51) *M*

Huffman, Lloyd C., Director, Dept. of Water, 310 Munic. Bldg., Dayton 2, Ohio (Jan. '51) *M*

Hulen, Carl S., Pres., Ulrich Chem. Co., Inc., 31 E. Georgia St., Indianapolis, Ind. (Jan. '51) *P*

Huntingburg Munic. Light & Water Dept., S. M. Paradiso, Supt., 6th & Van Buren, Huntingburg, Ind. (Corp. M. Jan. '51)

Hurlburt, H. Zeh, Research Engr., Consolidated Chem. Industries, Inc., Box 5275 Harrisburg Station, Houston, Tex. (Jan. '51)

Johnson, Elmer A., Cons. Engr., Johnson & McIntosh, Lincoln Theater Bldg., Lincoln, Calif. (Jan. '51) *PR*

Johnson, Harold M., *see* Thief River Falls (Minn.)

Jones, Ernest, Gen. Foreman of Distr., Water Dept., 614—9th Ave. N.E., Calgary, Alta. (Jan. '51)

Kansas City Board of Public Utilities, R. J. Duvall, Mgr. of Production & Distr., City Hall, 6th & Ann, Kansas City, Kan. (Corp. M. Jan. '51)

Knox, Joseph Carleton, Secy., New England Interstate Water Pollution Control Com., 73 Tremont St., Boston 8, Mass. (Jan. '51) *MPR*

Kohli, Wilson W., Cons. Engr., 98½ S. Washington St., Box 621, Tiffin 16, Ohio (Jan. '51) *PR*

Kreston, Max S., Engr., Dept. of Research & Development, Pacific Clay Products, 306 West Ave., Los Angeles 26, Calif. (Jan. '51) *PR*

Kurz, Frederick E., Vice-Pres. & Gen. Mgr., Service Coatings Corp., 214 Marine Ave., Wilmington, Calif. (Jan. '51)

Lawton, A. Marshall, Vice-Pres., Torrington Water Co., Box 26, Torrington, Conn. (Jan. '51)

Lewis, John A., Research Asst., Texas Experiment Station, Box 1645, College Station, Tex. (Jan. '51)

Libby, Maurice A., Supt., Bath Water Dist., 1 Lambard St., Bath, Me. (Jan. '51) *M*

Linberg, A. C., Cons. Engr., The Linberg Engr., Burlington, N.C. (Jan. '51) *MPR*

Locke, D. A., Field Engr., Fairbanks Morse & Co., 2008 S. Brook St., Louisville, Ky. (Jan. '51)

Mac Kay, J. D., City Engr., City Hall, Fredericton, N.B. (Jan. '51)

Makkonen, Osmo A. P., Chief Engr., O. Y. Yleinen Insinooritoimisto, Helsinki, Jalavatie 2, Finland (Jan. '51)

Mayfield, D. A., Jr., Secy.-Treas., Mayfield & Son Co., 131 E. Bay St., Jacksonville, Fla. (Jan. '51) *P*

McLaughlin, Carroll W., Civ. Engr. & Surveyor, 266 Fulton Ave., Hempstead, N.Y. (Jan. '51)

McLeod, C. S., *see* Colonial Terrace Inc.

Melbourne, City of, Charles R. Stickel, City Mgr., Melbourne, Fla. (Corp. M. Jan. '51)

Miller, Hughes F., Miller Assocs., Box 193, South Miami, Fla. (Jan. '51) *P*

Missouri Inspection Bureau, M. I. Parker, Chief Engr., 1330 Pierce Bldg., St. Louis, Mo. (Corp. M. Jan. '51)

Moffitt, William J., San. Eng. Asst., Dept. of Water & Power, 207 S. Broadway, Los Angeles, Calif. (Jan. '51) *MPR*

Monroe, Stanley G., Sr. San. Engr., U. S. Public Health Service, 10598 Riverview Dr., St. Louis 15, Mo. (Jan. '51)

Moore, Robert Condit, Engr., Elson T. Killam, Cons. Engr., 140 Cedar St., New York 6, N.Y. (Jan. '51) *PR*

(*Continued on page 36*)

(*Continued from page 34*)

Morgan, Fred E., Engr., Fred E. Morgan Co., 2409 W. 104th St., Chicago 43, Ill. (Jan. '51)

Morton, Francis L., Engr. of Pumping Stations, Eng. Dept., Waterworks & Sewerage Branch, Winnipeg, Man. (Jan. '51) *MP*

Natrona Water Co., Albert E. Clement, Asst. Supt., Natrona, Pa. (Corp. M. Jan. '51)

Nelson, Arthur W., Div. Supt., Gas & Water Dept., Southwestern Public Service Co., Borger, Tex. (Jan. '51)

Neumeyer, E. W., Supt., Missouri Utilities Co., Cape Girardeau, Mo. (Jan. '51)

Newell, William S., Chief Engr., Water Works Plant, Macomb, Ill. (Jan. '51) *P*

Nova Scotia Board of Comrs. of Public Utilities, James A. Hanway, Chairman, Provincial Administration Bldg., 195 Hollis St., Halifax, N.S. (Corp. M. Jan. '51)

O'Regan, Thomas, *see* Parrsboro (N.S.) Water System

Paradiso, S. M., *see* Huntingburg (Ind.) Munic. Light & Water Dept.

Parker, M. I., *see* Missouri Inspection Bureau

Parrsboro Water System, Thomas O'Regan, Chairman of Water Committee, Parrsboro, N.S. (Corp. M. Jan. '51)

Philen, Ernest Arvil, San. Engr., The Institute of Inter-American Affairs, c/o American Embassy, Mexico City, D.F., Mexico (Apr. '51) *MPR*

Pomona Valley Munic. Water Dist., Fred C. Froehde, Gen. Mgr. & Engr., 146 E. 3rd St., Pomona, Calif. (Corp. M. Jan. '51)

Porath, Marvin G., Water Supt., Gordon, Neb. (Jan. '51) *M*

Powers, Daniel S., Civ. Engr., Powers Eng. Co., 109 Anderson Bldg., Traverse City, Mich. (Jan. '51)

Puttee, Arthur Tyrrell, Asst. Engr. of Water Works & Sewerage, Winnipeg, Man. (Jan. '51) *MR*

Racicot, W. C., Supt., City Water Dept., Sandpoint, Idaho (Jan. '51) *MPR*

Redman, Rollin, *see* Fort Branch (Ind.) Water Works

Reh, Carl W., Engr., Greeley & Hansen, Engrs., 220 S. State St., Chicago, Ill. (Jan. '51) *PR*

Rendleman, George H., *see* Columbia (Mo.) Water & Light Dept.

Robinson, E. G., Salesman, Associated Chem. Co. of Canada, 432 Ontario St. W., Montreal 2, Que. (Jan. '51)

Roth, Stanford I., Supervisor of Water Collections, Div. of Water & Sewers, Phoenix, Ariz. (Jan. '51) *M*

Saavedra, Cesar, Student, State Univ. of Iowa, 125 N. Clinton, Iowa City, Iowa (Jr. M. Jan. '51)

St. Stephen Water Comrs., A. E. Dougherty, Supt., St. Stephen, N.B. (Corp. M. Jan. '51)

San Antonio City Health Dept., Philip N. Albright, Public Health Engr., 128 W. Commerce St., San Antonio 5, Tex. (Mun. Sv. Sub. Jan. '51)

Schooler, Adrian L., Supt., Water Works, Woodburn, Ore. (Jan. '51) *M*

Seevers, F. R., Sales Repr., Mueller Co., Kirkwood Hotel, Des Moines, Iowa (Jan. '51) *MPR*

Sellers, Jerry, *see* Cocoa (Fla.)

Sills, Titus Odell, Sr., Engr., Cannon Mills Co., Kannapolis, N.C. (Jan. '51)

Simmons, A. J., *see* Fayetteville (Tenn.)

Slayton, Leon K., Operating Engr., Water Dept., Sparta, Wis. (Jan. '51) *M*

Sloan, Walter John, Water Consultant, Eng. Dept., E. I. du Pont de Nemours & Co. Wilmington 98, Del. (Jan. '51) *PR*

Smith, Albert Ray, Public Health Engr., State Dept. of Health, 406 Center St., Des Moines, Iowa (Jan. '51)

Smith, Thomas Parshal, Public Health Engr., Leon County Health Unit, Box 1117, Tallahassee, Fla. (Jan. '51) *R*

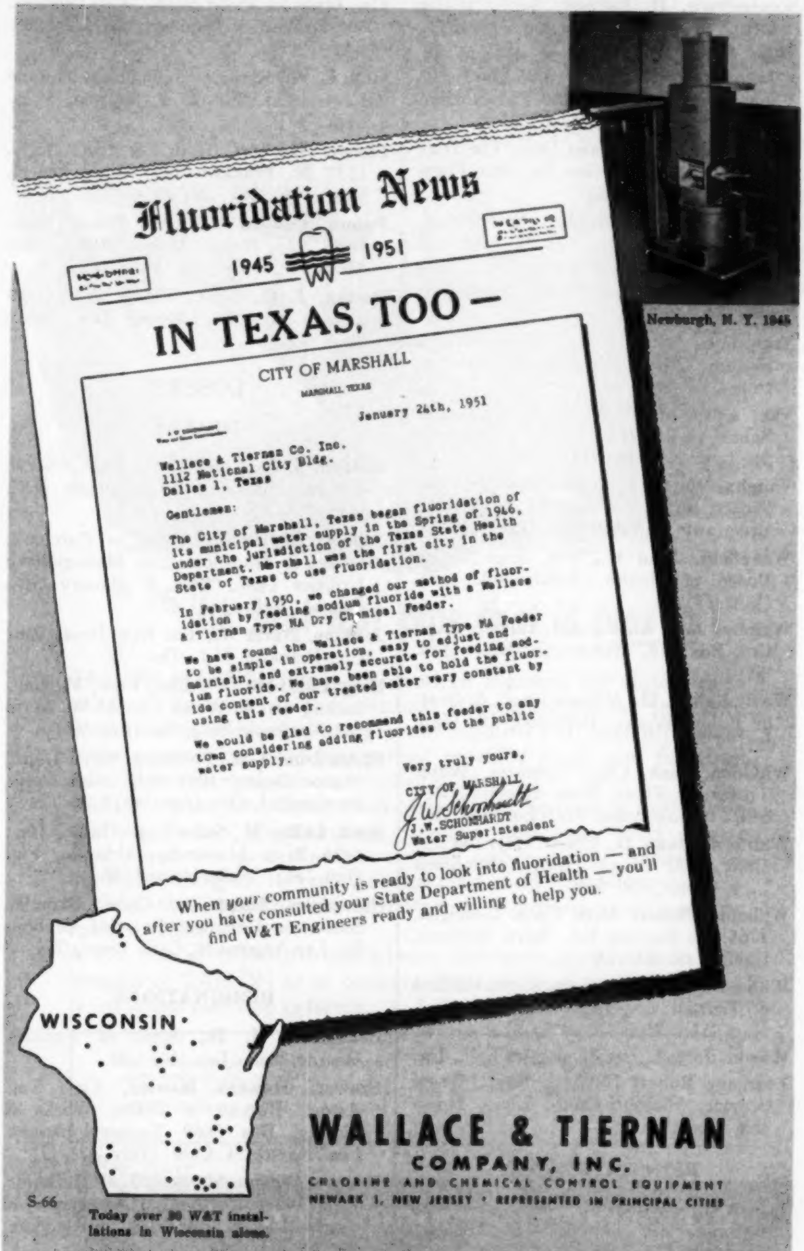
Smith, William Mellon, Sales Engr., Dorr Co., 1330 N. Industrial Blvd., Dallas, Tex. (Jan. '51)

Stevens, A. F., Owner, Stevens Southern Co., 2555 W. Beaver St., Jacksonville, Fla. (Jan. '51) *MPR*

Stickel, Charles R., *see* Melbourne (Fla.)

Stockton, Whatley, Davin & Co., Joseph W. Davin, Vice-Pres., 100 W. Bay St., Jacksonville, Fla. (Corp. M. Jan. '51) *MP*

(*Continued on page 38*)


Fluoridation News
1945 1951
IN TEXAS, TOO—
CITY OF MARSHALL
MARSHALL TEXAS
January 24th, 1951
Wallace & Tiernan Co. Inc.
1112 National City Bldg.
Dallas 1, Texas
Gentlemen:
The City of Marshall, Texas began fluoridation of its municipal water supply in the Spring of 1946, under the jurisdiction of the Texas State Health Department. Marshall was the first city in the State of Texas to use fluoridation.
In February 1950, we changed our method of fluoridation by feeding sodium fluoride with a Wallace & Tiernan Type NA Dry Chemical Feeder.
We have found the Wallace & Tiernan Type NA Feeder to be simple in operation, easy to adjust and maintain, and extremely accurate for feeding sodium fluoride. We have been able to hold the fluoride content of our treated water very constant by using this feeder.
We would be glad to recommend this feeder to any town considering adding fluorides to the public water supply.
Very truly yours,
CITY OF MARSHALL
J. W. Schonhardt
J.W. SCHONHARDT
Water Superintendent
When your community is ready to look into fluoridation — and after you have consulted your State Department of Health — you'll find W&T Engineers ready and willing to help you.
Newburgh, N. Y. 1945
WISCONSIN
Today over 30 W&T installations in Wisconsin alone.
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WALLACE & TIERNAN
COMPANY, INC.
CHLORINE AND CHEMICAL CONTROL EQUIPMENT
NEWARK 1, NEW JERSEY · REPRESENTED IN PRINCIPAL CITIES

(*Continued from page 36*)

Stoutenburg, H. LaFond, Supt., Water Dept., Stamford, N.Y. (Jan. '51) *PR*

Thief River Falls, City of, Harold M. Johnson, Chief Operator, Water Treatment Plant, Thief River Falls, Minn. (Mun. Sv. Sub. Jan. '51) *MPR*

Tholts, Edward D., Sales Div., The Dorr Co., Inc., 420 Market St., San Francisco, Calif. (Jan. '51)

Tillman, Melvin D., Dist. Sales Mgr., Alabama Pipe Co., 122 S. Michigan Ave., Chicago 3, Ill. (Jan. '51)

Tracy, John P., *see* Great Barrington (Mass.) Fire Dist.

Trousdale, E. A., Supt., Water Works System, 132 E. 2nd St., Mt. Vernon, Ind. (Jan. '51) *M*

Van Aulen, Paul B., Mgr., Lancaster Suburban Water Co., 339 N. Charlotte St., Lancaster, Pa. (Jan. '51)

Vaughn, Walter S., Chief Engr. of Water Works, Atomic Energy Com., 1440½ Broadway, Paducah, Ky. (Jan. '51)

Wakefield, John W., San. Engr, State Board of Health, Jacksonville, Fla. (Jan. '51)

Walters, John A., Partner, Walters Sand Co., Box 618, Manhattan, Kan. (Jan. '51)

West, Robert H., Village Engr. & Supt. of Public Works, Bellwood, Ill. (Jan. '51)

Whiddon, Jack, Chief Operator, Water Treatment Plant, State Hospital, Box 613, Chattahoochee, Fla. (Jan. '51) *MP*

Whitford, Stuart D., Chem. Engr., Water Dept., 203 Munic. Bldg., Oklahoma City, Okla. (Jan. '51)

Williams, Robert Neil, Cons. Geologist, 2765 Las Encinos Rd., Santa Barbara, Calif. (Jan. '51) *R*

Willis, Donald Albert, Sales Repr., Wallace & Tiernan Co., Inc., Newark 1, N.J. (Jan. '51) *P*

Wilson, John L., *see* Economics Lab., Inc.

Yeargain, Robert D., Asst. Engr., Water Service, Missouri-Pacific Lines, Houston, Tex. (Jan. '51)

REINSTATEMENTS

Blanch G., Osvaldo J., Urbanizacion San Antonio, Calle Olimpo No. 16, Caracas, Venezuela (Jan. '42)

Fly, Jesse L., Plant Supt., Water Works, 801 S. Wall St., Carbondale, Ill. (Jan. '48)

Hall, E. W., Resident Agent Engr., Layne Central Co., Box 2222, Jackson, Miss. (Apr. '47)

Moore, Herbert, Hydr. & San. Engr., 1330 N. Franklin Pl., Milwaukee 2, Wis. (July '28) *MPR*

Patera, Edward L., Pres., Patera Eng., Inc., 623 Royal Union Bldg., Des Moines 9, Iowa (Oct. '46) *MPR*

Poston, J. C., Supt., Public Works, 50 Coteau St., W., Moose Jaw, Sask. (Jan. '49)

LOSSES

DEATHS

Holden, J. C., Chief Power Engr., North Carolina Finishing Co., Salisbury, N.C. (Oct. '45) *P*

Jeffrey, Roy, Mgr., Dept. of Purchase, Stores & Transportation, Metropolitan Utilities Dist., 18th & Harney Sts., Omaha, Neb. (Jan. '47)

Jenkins, David W., The New Jersey Zinc Co., Franklin, N.J. (Oct. '22)

King, Elizabeth D. (Miss), Pres., Mechanicsburg Gas & Water Co., 53 W. Main St., Mechanicsburg, Pa. (Jan. '45)

Richardson, A. R., Foreman, Meter Dept., Water Dept., 1051 S.E. 56th Ave., Portland 15, Ore. (Jan. '45) *M*

Scott, LeRoy H., Sales Engr., Infilco Inc., 1221 Bryn Mawr St., Orlando, Fla. (Jan. '36) *Fuller Award '40.*

Stevenson, Ralph A., Cons. Chemist, Stevenson Chemical Co., 641 Gibbons St., Los Angeles 31, Calif. (Sept. '27) *P*

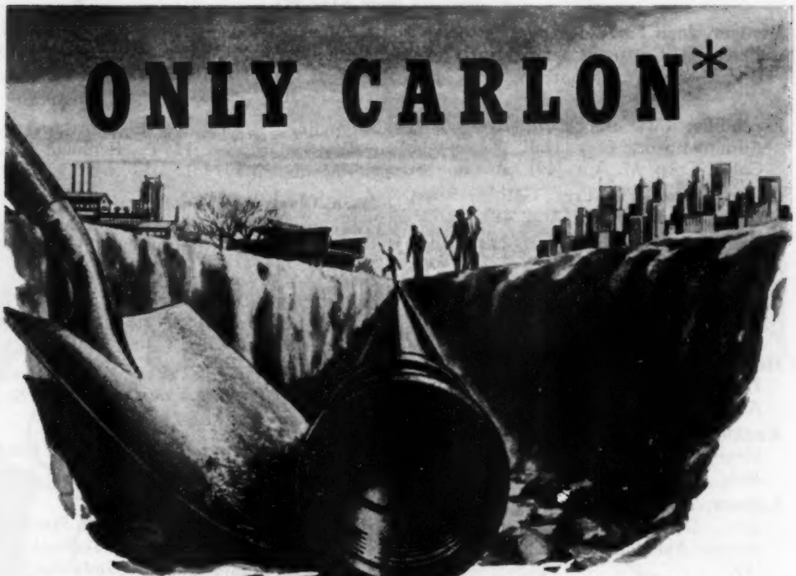
RESIGNATIONS

Beaumont, H. D., Supt. of Utilities, Hearne, Tex. (Jan. '44) *M*

Brewer, Howard Hawley, Civ. Eng. Assoc., Bureau of Water Works & Supply, Box 3669 Terminal Annex, Los Angeles 54, Calif. (July '42) *P*

Bristow, William M., Sr. Officer Mechanic, Bureau of Prisons, U.S. Dept. of Justice, Lock Box 250, Steilacoom, Wash. (Jan. '45)

(*Continued on page 40*)



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(*Continued from page 38*)

Deniger, Jean F., Sales Engr., Associated Chemical Co. of Canada, Ltd., 432 Ontario St., W., Montreal, Que. (Jan. '50)

Escondido, City of, C. M. Reed, City Administrator, City Hall, Escondido, Calif. (Corp. M. Apr. '49) *MPR*

Grotte, Sylvan, Vice-Pres., Glauber Brass, Inc., Kinsman, Ohio (Apr. '48)

Haimes, James, City Engr., Lethbridge, Alta. (July '43) *P*

Hannum, V. W., Supt., Water Dept., 518 S. Los Angeles St., Anaheim, Calif. (July '35) *M*

Herkenhoff, Gordon E., Cons. Engr., Herkenhoff & Turney, 223 Montezuma Ave., Santa Fe, N.M. (July '47)

Kunkle, Theodore P., Engr., Jones, Henry & Schoonmaker, 821 Security Bldg., Toledo, Ohio (July '48) *P*

Latimer, Thomas M., Assoc. Engr., Water Div., Dist. of Columbia Govt., 504 Wayne Ave., Silver Spring, Md. (Oct. '49)

Lee, Roderic B., Production Engr., Florida Power Co., St. Petersburg, Fla. (Jan. '50) *P*

Michau, R., Controleur des Services, Techniques et Industriels, 98 Quai de la Rapee, Paris 12, France (Mar. '27)

O'Neil, William James, Civil Engr., 3329 W. 24th Ave., Vancouver, B.C. (Oct. '49)

Pontusco Corp., Box 425, Baldwin Park, Calif. (Assoc. M. July '49)

Romine, Harrison E., R.R. 3, Tuscola, Ill. (Apr. '46) *R*

Rybolt, Charles H., Sales Mgr., Lucidol Div., Novadel-Agene Corp., 1740 Military Rd., Buffalo 5, N.Y. (Jan. '46)

Siems, Norman E., Sales Service Chemist, Philadelphia Quartz Co., Public Ledger Bldg., Philadelphia 6, Pa. (Apr. '48) *P*

Wilder, G. H., Operator, Water Works, 514 S. Broadway, Medina, Ohio (Apr. '43) *P*

CHANGES IN ADDRESS

Changes received between March 5 and April 5, 1951

Acevedo Quintana, F., Apartamento No. 31, Sordo a Pelaez No. 19, Caracas, Venezuela (Jan. '41)

Allen, Claris, Asst. Chief Engr., Indianapolis Water Co., Box 855, 113 Monument Circle, Indianapolis 6, Ind. (Jan. '45) *MR*

Augustine, C. V., North Central Ave. Water Utilities, 17 E. Pomona Rd., Phoenix, Ariz. (July '48)

Bach, Clayton M., Sr. Chemist & Bacteriologist, Water Dept., 43rd & Marshall Ave., N.E., Minneapolis 21, Minn. (July '42) *P*

Bethencourt, Daniel, Sociedad Cubana de Ingenierds, Avenida de Belgica No. 258, Havana, Cuba (Jan. '49)

Blackburn, Schuyler Coe, Deputy Director of Civ. Defense, 1804 E. 31st St., Baltimore 18, Md. (Jan. '42) *M*

Blaik, D. L., Pres. & Gen. Mgr., Leak Detector Co., 625 Hanna Bldg., Cleveland 15, Ohio (Apr. '39)

Brisbin, Sterling G., Graduate Student, Massachusetts Inst. of Technology, 210B Graduate House, Cambridge 39, Mass. (Jr. M. Oct. '50)

Britton, J., Gen. Mgr., The Canada Valve & Hydrant Co., Ltd., Brantford, Ont. (Jan. '50)

Brock, B. H., 420 E. Hamilton Ave., State College, Pa. (Jan. '44) *M*

Brodermann, Jorge, Civ. Engr., Calle 23, No. 1008, Vedado, Havana, Cuba (Jan. '49)

Brown, James R., Repr., Centriline Corp., 111 W. Monroe St., Chicago 3, Ill. (July '34) *M*

Budrick, Robert J., San. Engr., Jersey City Water Works, Box 387, Boonton, N.J. (July '49)

Bumstead, John C., Asst. Director, Ohio River Valley Water San. Com., 414 Walnut St., Cininnati 2, Ohio (Jan. '47) *M*

Calaway, Wilson T., Asst. Prof. of San. Science, Civ. Eng. Dept., Univ. of Florida, 814 N.E. 12th Ave., Gainesville, Fla. (Jan. '48)

Carlton, Frank, Sales Engr., Backflow Eng. & Equipment Co., 5725 Alcoa Ave., Los Angeles 11, Calif. (Oct. '39)

Caruthers, Dale Eugene, Hubbell, Roth & Clark, Inc., 13536 Artesian, Detroit 23, Mich. (Oct. '50)

(*Continued on page 42*)

(*Continued from page 40*)

Clark, R. A., Sales Repr., U.S. Pipe & Foundry Co., 817 Citizens State Bank Bldg., Houston, Tex. (Apr. '48)

Colston, Robert, Consultant, 53 W. Jackson Blvd., Chicago 4, Ill. (Apr. '41) *P*

Concord Board of Light & Water Comrs., J. C. Slough, Foreman, Water Dept., Concord, N.C. (Corp. M. Apr. '43)

Copeland, Kern Hadley, Lt. Col., 0-110760 U.S. Army, Hospital, Camp Stoneman, Calif. (July '47) *P*

Corle, Vernon B., Mgr., New Castle Water Co., 31 N. Mill St., New Castle, Pa. (Oct. '43) *MP*

Cowser, Kenneth E., San. Engr., State Dept. of Health, 807½ S. Neil St., Champaign, Ill. (Jan. '49)

Cunitz, George R., Floyd G. Browne & Assocs., 196 S. Main St., Marion, Ohio (Oct. '47)

Damberg, John F., Sales Engr., Wallace & Tiernan Co., 1229 W. Washington Blvd., Chicago, Ill. (Oct. '46)

Davis, W. P., 1960 Oak Knoll Dr., Belmont, Calif. (Oct. '45)

Denney, Howard M., *see* Maywood (Ill.)

Deo, R. R., Mgr., Paterson Eng. Co. (India), Ltd., 21, Theatre Rd., Calcutta 16, India (Oct. '38)

Dunn, Wheeler W., Jr., Contractor, Route 1, Box 197, Jackson, Miss. (July '49)

Dunn, William E., San. Engr., State Board of Health, 52 Caldwell Bldg., Tallahassee, Fla. (Jan. '49)

East Bay Munic. Utility Dist., John W. McFarland, Gen. Mgr., 512—16th St., Oakland 4, Calif. (Corp. M. Sept. '29)

Edwards, S. Everett, Chemist, Bureau of Water Supply, Montebello Filters, Hillen Rd., Baltimore 12, Md. (July '42) *P*

Egan, Joseph H., 1831—7th Pl., Arcadia, Calif. (Oct. '31)

Elsener, L. A., Dist. Sales Mgr., Chicago Bridge & Iron Co., Room 616, 200 Bush St., San Francisco 4, Calif. (Apr. '44)

Finch, Lewis S., Vice-Pres. & Chief Engr., Indianapolis Water Co., 113 Monument Circle, Indianapolis 6, Ind. (Oct. '33) *Fuller Award '49. MPR*

Firth, William J., Box 76, Roanoke, Va. (Jan. '43) *MP*

Fox, Paul S., Chief of Field Party, Health & San. Div., Inst. of Inter-American Affairs, U.S. Embassy, San Jose, Costa Rica (Oct. '24) *P*

Frank, Otto B., Box 9425, Laguna Beach, Calif. (July '35) *MPR*

Fredenall, Mercer W., Mgr., Pipeline Div., F. J. Moran & Son, Route 1, Palmer Canyon, Claremont, Calif. (Apr. '50) *M*

Friedman, Benno, Mech. Engr., The Israel Water Meter Industry, 12 Hasharon St., Tel Aviv, Israel (Oct. '45)

Gibeau, H. A., Director of Public Works, 275 Notre-Dame St., Montreal, Que. (Apr. '45) *MP*

Glens Falls Board of Water Comrs., Garner C. Tripp, Jr., Supt., Glens Falls, N.Y. (Munic. Sv. Sub. Oct. '18) *M*

Glidden, A. Leland, Ranney Constr. Co., 4395 Poplar Level Rd., Louisville 13, Ky. (July '35)

Goit, Laurance E., Engr., Los Angeles Aqueduct, Dept. of Water & Power, Box 3669 Terminal Annex, Los Angeles 54, Calif. (Oct. '34) *Goodell Prize '37. MPR*

Goldman, Ernest E., Engr., C. A. "Riego," Aptdo. 1844, Caracas, Venezuela (Apr. '44)

Gonzalez Jiminez, Rafael Erasmo, Cons. Engr., Cienfuegos No. 159, Havana, Cuba (Jan. '50) *R*

Graham, Howard E., Asst. Supt., Water Service, Illinois Central System, 8805 S. May St., Chicago 30, Ill. (Oct. '43)

Gray, Alexander, Water Bureau, 10 Felix St., Rochester 6, N.Y. (Jan. '46)

Hansen, Robert E., Supt., Water Dept., Filtration Plant & Pumping Station, Route 8, 36570 Jefferson, Mt. Clemens, Mich. (Jan. '47)

Harding, Howard V., *see* Hudson (N.Y.) Dept. of Public Works

Harding, Robert W., 200 Auditorium Circle, San Antonio, Tex. (Oct. '35) *Fuller Award '46.*

Hardy, Charles B., Supt., Bureau of Water, 20 E. Worcester St., Worcester 4, Mass. (July '42) *M*

Haywood, R. W. Jr., E. I. du Pont de Nemours & Co., Eng. Dept., Wilmington 98, Del. (Jan. '37) *P*

(*Continued on page 44*)

(*Continued from page 42*)

Helena Water Dept., J. R. Kaiserman, Mayor, Civic Center, Helena, Mont. (Corp. M. Jan. '37)

Hespeler, Town of, Water Works Com., O. M. Kennedy, Town Clerk, Hespeler, Ont. (Jan. '50) *M*

Hew, Benedict Y. C., *see* Honolulu (Hawaii) Suburban Water System

Hoefle, Karl F., Supt., Water Dept., 2125 Commerce St., Dallas 1, Tex. (Apr. '40) *MPR*

Honolulu Suburban Water System, Benedict Y. C. Hew, 405 City Hall, Honolulu, Hawaii (Corp. M. Oct. '49) *MPR*

Hudson Dept. of Public Works, Howard V. Harding, Supt. of Public Works, City Hall, Hudson, N.Y. (Munic. Sv. Sub. Jan. '48)

Indiana Girls School, Mrs. Margaret Sumner, Supt., R.R. 2, Box 440, Indianapolis 44, Ind. (Corp. M. July '49)

Jens, Stifel W., 101 S. Meramec Ave., St. Louis 3, Mo. (Jan. '44) *R*

Johnston, Lewis Z., Jr., Town Mgr., Farmville, Va. (Jan. '47)

Kaiserman, J. R., *see* Helena (Mont.) Water Dept.

Kennedy, Anthony J., Asst. Gen. Mgr. & Engr., Water Dept., Box 826, Riverside, Calif. (Jan. '43)

Kennedy, O. M., *see* Hespeler (Ont.)

Kennedy, Robert Charles, Chief Engr., East Bay Munic. Utility Dist., 512—16th St., Oakland 4, Calif. (May '33) *M*

Lamb, James C., III, 284 Westgate West, Cambridge, Mass. (Oct. '49)

Lange, Kenneth W., Contracting Engr., Chicago Bridge & Iron Co., Room 616—200 Bush St., San Francisco 4, Calif. (Jan. '48) *M*

Lasaga, Andres, c/o Jorge Gomez V., Riva Palacio 715 Int., N. Laredo, Tamaulipas, Mexico (Jan. '43) *P*

Lee, John Douglas, Assoc. Prof., Dept. of Civ. Eng., Queen's Univ., Kingston, Ont. (Oct. '43) *MPR*

Lemasters, Paul R., Plant Engr., Indianapolis Water Co., 113 Monument Circle, Indianapolis 6, Ind. (Jan. '47)

Leonard, W. V., Box 771, Salmon, Idaho (Apr. '39) *Fuller Award '47.*

MacPherson, William, Box 2202, Richmond, Va. (July '49) *MP*

Marsh, John A., Supt., Baldwin Filtration Plant, 11216 Fairhill Rd., Cleveland 4, Ohio (Apr. '37) *P*

Marthinsen, John, San. & Civ. Engr., 653 Spring Garden St., Easton, Pa. (Jan. '51)

Matthews, John Lepère, Mgr., Munic. Authority of Westmoreland County, 250 S. Pennsylvania Ave., Greensburg, Pa. (Jan. '50) *M*

Mau, Francis, K. Y., 1840—Kahakai St., Honolulu, Hawaii (Jan. '49) *PR*

Maywood, Village of, Howard M. Denney, Water Dept., 125 S. 5th Ave., Maywood, Ill. (Corp. M. Apr. '49)

McCarthy, Edward J., Pres., Ed. A. McCarthy & Son, Inc., 2305 Clifton Ave., Cincinnati 19, Ohio (Oct. '49)

McCormick, Robert E., 1801—2nd Ave. S., Great Falls, Mont. (Apr. '49) *P*

McElroy, U. F., Div. Engr., California Water & Telephone Co., 439 Tyler St., Monterey, Calif. (Jan. '49) *MR*

McFarland, John W., *see* East Bay Munic. Utility Dist.

McKee, Donald M., Dist. Mgr., The Permutit Co., 4612 W. 61st St., Mission, Kan. (Jan. '48) *P*

McLean, Lowell G., Boyle Eng. Office, 327 Spurgeon Bldg., Santa Ana, Calif. (Oct. '50) *M*

Mellen, Arthur F., 3104 Dupont Ave., N., Minneapolis 11, Minn. (Mar. '15) *Fuller Award '43. MP*

Monie, William D., 319 Merion Ave., Haddonfield, N.J. (Oct. '50)

Moore, Clyde N., Jr., Div. Engr., Water Dept., 215 W. Broadway, Long Beach 2, Calif. (Apr. '49) *M*

Nason, Edward McKinney, R.R. 1, Moncton, N.B. (Apr. '49)

Nilmeier, Herbert P., 277 Glorietta Blvd., Orinda, Calif. (Jan. '45) *P*

Noble, John A., Tech. Sales Repr., H. L. Blachford Ltd., 22 College St., Toronto, Ont. (Jan. '51)

Ogden, Willis L., 1402 E. Grove St., Bloomington, Ill. (Nov. '43) *MP*

Osborn, William D., 2262 Rincon Dr., Whittier, Calif. (Jan. '46)

(*Continued on page 46*)

(*Continued from page 44*)

Payne Dean & Co., Payne Dean, Pres., Clinton, Conn. (Assoc. M. Oct. '43)

Peterson, Thoburn F., 329 Winslow St., Watertown, N.Y. (Jan. '50)

Phillips, Robert S., MSC, Environmental Health Lab., Army Chem. Center, Md. (Oct. '35)

Phillips, William Fred, Power Machinery Co., 1213 C North Osage Dr., Tulsa, Okla. (Apr. '50)

Pomares, Marino L., Jr., Partner, Culligan Soft Water Service, 3516 Highland Ave., Manhattan Beach, Calif. (Jan. '50

Poulter, Alfred F., Box Eye, National City, Calif. (Jan. '37) *MPR*

Pratt, Jack W., 1610 Francis Ave., Belmont, Calif. (Jan. '41) *P*

Pritchard, John C., Cons. Engr., Route 1, Magnolia, Miss. (Feb. '26) *P*

Revell, Rufus Benjamin, 701 N. Jefferson St., Marianna, Fla. (Jr. M. Oct. '49) *MP*

Richardson, Andrew K., Sales Repr., Worthington-Gamon Meter Co., La Salle Hotel, South Bend, Ind. (Oct. '46)

Rihm, Alexander, Jr., 8566—80th St., Woodhaven, N.Y. (July '43) *PR*

Risquez C., Alfonso A., Div. Ingenieria Sanitarie, Edificio Coronado III Piso, Caracas, Venezuela (Apr. '49)

Riverside Water Dept., L. W. Grayson, Gen. Mgr. & Chief Engr., Box 826, Riverside, Calif. (Corp. M. July '26) *MR*

Runyan, Damon Ogden, 1111 Stout St., Denver, Colo. (Oct. '47) *MPR*

Rutt, Raymond, Secy., Northern Illinois Water Corp., 105 W. Adams St., Chicago 3, Ill. (Jan. '47 *M*

Sanchis, Joseph M., San. Engr., Dept. of Water & Power, 2745 Medlow Ave., Los Angeles 65, Calif. (Oct. '34) *P*

Schneider, Reynolds, Supt., Water Dept., Holly, Mich. (July '46) *MP*

Scott, Walter M., 472 Gramatan Ave., Mount Vernon, N.Y. (Apr. '38)

Shoup, Robert E., Supt., Water Works, 615 E. Main St., Van Wert, Ohio (July '48)

Sigler, Clark & Winston, Cons. Engrs., S. C. Clark, Box 478, Weslaco, Tex. (Corp. M. Oct. '46) *MPR*

Silberbauer, Walter R., Santa Clara County San. Dist. No. 4, Sewer Maint. & Inspection, 101 Bland Ave., Campbell, Calif. (Oct. '43) *M*

Slough, J. C., *see* Concord Board of Light & Water Comrs.

Stockman, Robert L., Dist. Engr., State Dept. of Health, Route 2, Box 407, Bellevue, Wash. (Oct. '47) *MP*

Stockwell, Henry P., Jr., Deputy Comr. of Water Works, Transportation Bldg., Ottawa, Ont., (Jan. '33) *MP*

Stowe, Charles R., Mgr., Products Div., Carlon Products Corp., 10225 Meech Ave., Cleveland 5, Ohio (Jan. '50)

Streit, John Henry, San. & Sales Engr., Wallace & Tiernan Sales Corp., 2905 Locust, Denver, Colo. (Jan. '50) *P*

Sumner, Margaret (Mrs.), *see* Indiana Girls School

Tebar Escribano, Miguel, Chief, Meter Div., Dept. of Operation, Instituto Nacional de Obras Sanitarias, Tienda Honda a Puente 1a, Trinidad 62, Caracas, Venezuela (July '50) *M*

Tom, Albert Q. Y., 2512 Puaena Pl., Honolulu, Hawaii (Jr. M. Jan. '49)

Tripp, Garner C., Jr., *see* Glens Falls (N.Y.) Board of Water Comrs.

Twohy, Frank, Controller, Dept. of Water & Power, Box 3669 Terminal Annex, Los Angeles 54, Calif. (Oct. '43) *M*

Vander Velde, T. L., Chief, Div. of Water Supply, State Dept. of Health, Lansing 4, Mich. (Oct. '45) *PR*

Waller, Robert O., Civ. Engr. III, Water Purification Div., 220 S. State St., Chicago 4, Ill. (May '33) *P*

Walling, I. W., Dist. Chemist, U.S. Geological Survey, 126 Irrigation Dept., Univ. of California, Davis, Calif. (Jan. '49) *PR*

Ward, James W., Student, Massachusetts Inst. of Technology, 99 Westgate, Cambridge 39, Mass. (Oct. '50)

Werth, Conrad Walter, Supt. of Filtration, Board of Water Comrs., 3363 W. Clyde Pl., Denver 11, Colo. (Jan. '36) *P*

Whitley, F. H., Lt. Col., MSC, Medical Sec., Headquarters EUSAK, APO 301, c/o Postmaster, San Francisco, Calif. (Jan. '39) *PR*

Wintz, Edward R., 49 Willow Ave., Walnut Creek, Calif. (Oct. '40)

Condensation

Key: In the reference to the publication in which the abstracted article appears, 39:473 (May '47) indicates volume 39, page 473, issue dated May 1947. If the publication is paged by the issue, 39:5:1 (May '47) indicates volume 39, number 5, page 1, issue dated May 1947. Abbreviations following an abstract indicate that it was taken, by permission, from one of the following periodicals: *B.H.—Bulletin of Hygiene (Great Britain); C.A.—Chemical Abstracts; Corr.—Corrosion; I.M.—Institute of Metals (Great Britain); P.H.E.A.—Public Health Engineering Abstracts; S.I.W.—Sewage and Industrial Wastes; W.P.R.—Water Pollution Abstracts (Great Britain).*

ADMINISTRATION

Luxury Tax. ANON. Water (Neth.) 35:2 (Jan. 18, '51). Beginning Jan. 1, '51, a luxury tax of 15% placed on water used in boilers and hot water heaters. Tax starts with heaters having a capacity of 8 gal., which includes all heaters for showers and baths.—*W. Rudolfs.*

Rating Water and Sewage Works for the Year 1950. ALEKSANDER TAFF. Gaz, Woda i Techn. Sanit. (Pol.) 24:445 (Dec. '50). During first half of 1950 seven of largest water and sewage works admins. were rated. Rating difficulties are described and author hopes that others will become interested enough to help in developing parameters suitable for rating production, management and operation, similar to those used in industrial establishments. He states that no other industry operates under such a complete cycle as does water supply because bound to: [1] prepare water for use, [2] carry water to ultimate consumer, [3] carry waste products from point of dischg., and [4] operate and maint. distr. system in readiness to provide for catastrophes such as fire. In addn. to these operations, water and sewage works organizations must design and build addnl. units and plant facilities with own staffs or others. In first ratings comparisons were made only on basis of operating results. It is hoped to encompass all operations in future rating anals. Ratings should be made on annual basis rather than semiannual to avoid effects of seasonal variation. Through use of illustrative examples author shows difficulty of making comparisons between plants, since plants that have been operating very well may obtain no additive values to their ratings. Plants that showed some improvement but are considerably worse than other good plants, however, show additive values and percentage points, and therefore, are shown as having made excellent progress during the year although their operation may be much poorer than that of good plants. For example, when appraising cost of water to consumer, consideration must be given to water source, quality, treatment required, age of distr. system, pumpage required and other factors for each plant, and these will certainly vary greatly. In conclusion authors suggests advisability of establishing normal values for all parameters for each plant to be rated and making comparisons on how closely plant operated with respect to these norms.—*C. P. Straub.*

KIWA Ltd.—A New Organization Formed in The Netherlands. J. E. CARRIERE. Wtr. & Wtr. Eng. (Br.) 54:106 (Sept. '50). About a yr. after liberation of Netherlands, Netherlands Waterworks Assn. in collaboration with Inst. of Water Engrs. in Netherlands, founded Institute for Testing of Waterworks Materials (KIWA). Its instruction was not only to test water works materials but to promote cooperation between water works labs. and to coordinate research work of water works undertakings in Netherlands.

(*Continued on page 50*)

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(Continued from page 48)

As early as '34 "Committee for Testing Waterworks Articles" (KCW) had been formed. Activities of KCW grew to such extent that it became necessary to found new institute. Consequently, KIWA formed in '48 as limited company which all water works in the Netherlands might join as shareholders. New institute officially formed Aug. 5, '49, with nominal capital of £10,000. KIWA began in small way by examining all kinds of materials manufactured in Netherlands and started with testing of bituminized steel pipe. Service pipes leaving factory must be provided with seal from KIWA. Later KIWA came to similar arrangement with only factories manufacturing cast-iron and asbestos-cement pipes. Total value of materials provided with KIWA mark in '48 amounted to about £450,000. During '48 KIWA supervised during manufacture and tested materials to value of about £1,400,000. All data concerning manufacturing processes and factory output are kept secret. Second task of KIWA is promotion of cooperation between water works labs. In Holland both unpurified and purified water of all water supplies are examined annually by govt. Inst. for Public Health. Water of 66 utilities examined periodically through KIWA. Committee of assistance is central authority for coordination of research work. KIWA has set up number of research committees, such as: Central Corrosion Com. and Com. for Field Data (on corrosion) on Iron Pipelines. Four new committees founded by KIWA are: Construction of Rapid filters; Prevention of Water Waste; Construction of Supply Pipelines; and Damage by Frost. An engr. acts as secy. of all committees.—*H. E. Babbitt.*

Reconstruction and Water Supply Administration. Eugeniusz Gorecki. Gaz, Woda i Tech. Sanit.

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(Pol.), **24**:305 (Sept. '50). Author states that growth of distr. system should parallel pop. growth and expansion of water works facilities should increase more rapidly (2.5 times in Russia) than pop. growth to keep ahead of std. of living. During 1950–55 400 engrs. and 1600 technicians versed in water supply and sewage disposal needed. Suggested that water and sewage investigations be postponed to second half of 6-yr. period to permit more rapid training. Organization of effort divided into 3 phases: planning, constr. and operation. Author calls attention to Russian water supply admin. practices because of her experience in this field under a socialistic govt.—*C. P. Straub.*

TREATMENT—GENERAL

Removal of Salt From Sea Water. Arthur M. Buswell (to the U.S.A., as represented by the Secy. of the Navy). *U.S. 2,522,856* (Sept. 19, '50). Sea water is made potable by addn. of Ag_2SiF_6 and $Ca(OH)_2$. The process is carried out by first adding the Ag_2SiF_6 to sea water. After the solids are settled, the H_2O is decanted and filtered, and CaO is added to the filtrate. When the reaction is completed, the solids are allowed to settle, and the supernatant H_2O is ready for drinking. One gal. of sea water requires 348 g. of Ag_2SiF_6 and 12.3 g. of CaO.—*C.A.*

Purification of Water on a Small Scale. H. J. Anderson. J. Roy. Army Med. Corps (Br.), **93**:187 ('49). The development of methods for providing small parties of troops or individual soldiers with safe water supplies in the field is outlined. A description is given of former methods of water supply used in the Army, and of various tests carried out to find a suitable method of purif., by addn. of bromine, iodine, chlorine, sodium bi-

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sulfate, potassium permanganate, copper sulfate or alum, by filtration or by heat. The Horrocks Box with equip. for treatment by chloride of lime, devised in 1914, still in use. As chloride of lime unstable in hot climates, a mixt. of $\frac{7}{8}$ bleaching powder and $\frac{1}{8}$ quicklime, known as water sterilizing powder, has now been adopted as std. by British Army. One objection to chlorination was that taste remained after treatment, but discovered in 1938 that this taste could be elimd. by overchlorinating, followed by removal of excess chlorine by sodium thiosulfate. Advantages of superchlorination are that period of contact required is reduced from 30 to 15 min., removal of chlorine by reaction with org. matter is less important, and underdosing less likely to occur. The water sterilizing powder is added in sufficient doses to give 2 ppm. free chlorine after reaction with org. matter has occurred. After 15 min., excess chlorine is removed by the addn. of sodium thiosulfate at the rate of 1 g. per 100 gal. Later, the halazone method was developed for individual soldiers. In this method a sterilizing tablet containing 3 g. of a mixture of 7.5% halazone, 10.5% anhydrous sodium carbonate, and 82% anhydrous sodium chloride is added to the water bottle and after 15 min. the water is dechlorinated with a second tablet containing $1\frac{1}{2}$ g. of a mixt. of 85% sodium chloride and 15% anhydrous sodium thiosulfate. These individual outfits are not ideal as the chlorinating tablets do not dissolve easily and the dechlorinating tablets may turn into a sticky mass. Expts. were carried out between the two world wars to improve the portable clarifying apparatus, and two similar types of compact pressure filters, the Meta and the Stellar, were designed. Each consists of a cylindrical metal chamber surmounted by a moveable metal head to which is fixed a "core" composed of a number of flat

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non-corroding metal rings and washers, which serve to support the filter medium and a wire gauze sleeve. The filter medium consists of a specially prepared Kieselguhr coated with silver and mixed with aluminium hydroxide. Midget filters for small parties have been produced. As a result of the needs of paratroops, the Millbank Filter Bag was evolved. This is a "chain weave" light canvas bag, approximately 4″ across and 12″ deep, one side being slightly longer than the other. It is first wet thoroughly, then filled with water and hung up on a stick. The filtered water is then disinfected by halazone tablets. It is claimed that two products made in America in 1944, and not yet available in Britain, will kill pathogenic bacteria, cysts, and cercariae in 10 minutes. These compounds are diglycine hydriodide phosphate (Bursoline) and triglycine hydriodate phosphate (Globaline). A portable detector for testing water for radioactivity has been designed, but has not yet been accepted for service use. A brief account is given of methods of purif. used by other armies.—*W.P.A.*

Production of Fresh Water from Sea Water and Similar Saline Waters in Hot Countries. C. Reichle & H. Keller. Kl. Mitt. Ver. Wasser-, Boden- u. Lufthyg., **19**:1 ('43). The authors discuss the provision of water supplies in hot countries, with special reference to utilization of the sun's heat for distn. of saline water.—*W.P.A.*

Reducing Fluoride Concentration in Water Supply Systems. Franz J. Maier. *U.S. 2,531,451* (Nov. 28, '50). To obtain water contg. 1.0–1.5 ppm. of sol. fluoride, water blended with NaF to produce a concn. of 6–7 ppm. is treated with sufficient $Al_2(SO_4)_3$ soln. and a clay suspension to maint. a concn. of 390 ppm. of the

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coagulant and a turbidity equiv. to 100 ppm. of clay. NaOH is added in sufficient amt. to keep the pH at 6.7. The influent is agitated and passed through a succession of basins to permit flocculation until it enters the settling tank and leaves the latter through a rapid-sand mech. filter. Thus treated, the water shows a fluoride concn. of approx. 1.0 ppm. The coagulant and turbidifier are preferably added by means of mech. proportioners.—*C.A.*

Removal of Fluoride from Domestic Water Supplies. M. E. Gilwood & George Swen. *Unpublished paper presented at Arizona Section, A.W.W.A.* (April 1, '49). Water Works Engineering, **103**:1023, 54 (Nov. '50). Three processes for reducing the fluoride content of waters are discussed: magnesia process; alum coagulation; and passage through a regenerable bed of granular phosphatic material (such as Fluo-Karb). *Magnesia process:* In waters contg. sufficient magnesium hardness fluoride is reduced to an acceptable level of 1.0 to 1.5 ppm. by conventional water treatment when the magnesium is pptd. as magnesium hydroxide. Units such as the Spaulding Precipitator, utilizing a sludge blanket, are recommended for this process. For waters low in magnesium, epsom salts or activated magnesium oxides may be added to supply magnesium ion. This type of treatment results in high chemical cost for treatment. Dolomitic lime ($Ca(OH)_2MgO$) instead of the usual high calcium lime ($Ca(OH)_2$) usually used in water softening may be used as an economical source of increasing the magnesium content of the water prior to softening. The process is particularly applicable to waters contg. appreciable amounts of bicarbonate and free carbon dioxide. Waters too low in magnesium hardness or in bicarbonate or carbon dioxide may be carbonated. Some of the sludge from the dolomitic lime treatment is recirculated to the raw water. The carbon dioxide and bicarbonate dissolve some of the magnesium oxide. When the water and recirculated sludge pass into the sludge blanket unit, where the dolomitic lime is added, the dissolved magnesium is precipitated. The installation and chem. operating cost for such a plant is only a trifle higher than for a std. lime softening installn. Increased cost may occur due to the fact that 50 per cent more dolomitic lime must be fed, in order to obtain the same deg. of softening of the water. *Alum treatment:* Considerable amts. of alum are required for fluoride removal by alum. Unless a water does not contain appreciable amounts of magnesium hard-

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ness, bicarbonate ion or free carbon dioxide, alum treatment is usually more expensive than the magnesia treatment in the removal of fluoride. *Fluoride removal by Fluo-Karb:* Fluo-Karb is a granular, specially treated bone that removes fluorides upon simple passage of the water through a column of the material. When satd., the Fluo-Karb is regenerated by passing a 2–5% sodium hydroxide soln. through it. The material is rinsed and dilute acid introduced, followed by further rinsing. Commercial or household units available.—*P.H.E.A.*

Coagulation of Water and Wastes with Zinc Salts. William Seifriz & Eugene J. McCue (to Edward S. Mead). *U.S. 2,511,299,* June 13, '50. Colloids in coal-washery water and similar wastes flocculated by raising pH to 10.6 with NaOH, $Ca(OH)_2$, Na_3PO_4, etc., then adding 17–35 ppm. $ZnCl_2$. Addn. of Zn salt also aids causticized starch coagulant at pH above 9.0. Effectiveness of Zn is explained by 18 electrons in second inner shell, in contrast to alk. earth bivalent ions which have 8. Coagulation is accomplished by discharging, dehydrating the water mantle about org. particles, and mech. action of flocculent hydroxide ppt.—*C.A.*

Practical Applications of Activated Silica Sols as Coagulant Aids. A. B. Middleton. Proc. Md.-Del. W. & Sew. Assn., p. 45 ('49). The use of activated silica as a coagulant in the treatment of water is described. "Activated silica" contains negatively charged colloidal particles and is prepared by the reaction of a dil. soln. of sodium silicate with a dil. soln. of an acidic material, such as sulfuric acid, ammonium sulfate, chlorine, or sodium bicarbonate. As a result of using N-Sol-A (an activated silica sol in which ammonium sulfate is the reacting acidic material) at the water

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works of Houma, La., the rate of flow which can be treated in conventional sedimentation tanks and in an Accelator has increased, a high content of residual chlorine is maintd. without addl. costs, there is a reduction in all chemicals used with the exception of carbon and chlorine, a reduction in cost of 30–50 per cent was achieved, and taste, bacterial quality and appearance of the water were improved. Activated silica sols have been used with some success in the treatment of sewage. By the use of silica in the treatment of oil refineries waste waters, the rate of flow through conventional and upward-flow types of equipment could be doubled without loss of efficiency. In discussion F. A. Eidsness states that activated silica is of particular use in the treatment of water with a very low turbidity and for waters at low temperatures.—*W.P.A.*

Method of an Apparatus for Purifying Raw Water From Humic Substances. A. M. R. Karlström. *B.P. 622,282.* In a process for removing colloidal humic substances from water, the raw water is aerated, treated with a water-sol. salt with a trivalent positive ion, such as aluminum sulfate, and agitated slowly. The floc formed under these conditions encloses air bubbles and can be removed by flotation. A small proportion of a negatively charged colloid, such as animal glue, may be added after flocculation; this will bind small flocs together, will stabilize flocs, and will increase the capacity of the flocs for holding air bubbles. Apparatus is described.—*W.P.A.*

Clarification of Drinking Water. Library of Congress, 202 pp. This report, prepared by New York Univ. under contract to the Army Eng. Research and Development Labs., is a comprehensive study of the theory and practice involved in the clarification of drinking water. It includes a critical review of the literature, an anal. of the effect of salts upon alum floc formation; and exptl. work dealing with removal of colloidal turbidity.—*P.H.E.A.*

Treatment of Arsenical Waters With Lime. R. A. Trelles & F. D. Amato. Rev. Obras Sanit. Nacion (Arg.), **13**:95 ('49). In a number of locations the only water supply has a relatively high As content. In some regions waters contg. 0.15–0.25 mg./l. As are used without reported ill effects, despite accepted limit of 0.10 mg./l. As for potable water. The usual removal of As is by Fe or Al floc, followed by filtration and pH adjustment. It has been found that treatment with CaO alone, pptg.

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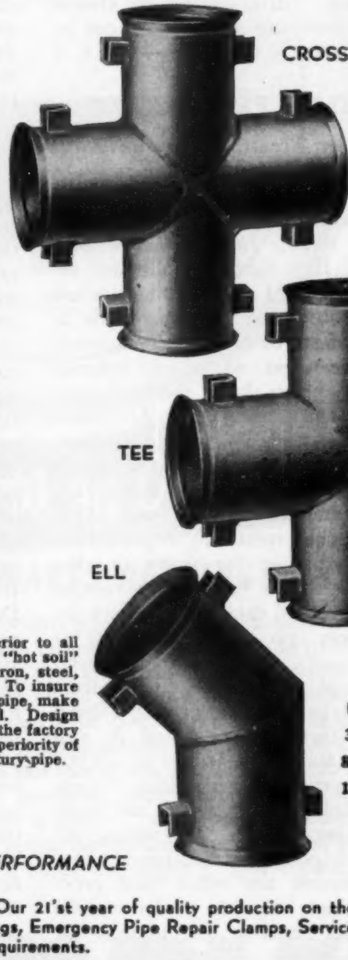

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$CaCO_3$ or $Mg(OH)_2$, reduces As content. Three examples given. A deep well water before and after treatment with 156 mg./l. CaO had the following properties, resp.: pH 7.9, 10.8; total hardness as $CaCO_3$, 167, 102; As in mg./l., 1.0, 0.16. Adjustment of the pH of treated water by recarbonation is advised. Turbid waters are cleared by this treatment, which does not increase sulfate in the water.—*P.H.E.A.*

BOILER FEEDWATER

Feedwater Treatment in the Packing House (Internal vs. External). MYRON B. GOLBER. *Unpublished paper presented at Midwest Power Conference, Illinois Inst. of Technology, Chicago, Ill.* Advance in boiler design has resulted in more intensive use of heat absorbing surface. This in turn has fostered new developments in water treatment of which external softening plants have received most attention in technical publications. Numerous steam generators, however, continue in service after extended use of internal treatment, and despite improved external softening now available, internal treatment continues to have advantages for many installations. Decisions based upon specific applications and data presented are derived from opn. of larger plants of Armour and Co. Installations considered range from HRT and 4-drum Stirling type boilers to modern 2-drum integral furnace types, and in size from 60- and 80-hp. boilers to 125,000 lb. per hour steam generators. Steam uses include water, comfort and process heating, electric generation, air and refrigerant compressor opn. Packinghouses and other food processing plants operate under special restrictions because of toxicity or effect on quality of some chems., but otherwise can use any water treatments now offered. Actual selection of treatment to be employed depends upon chem., mechanical and economic factors. At Peoria plant, a new 3-drum water wall boiler and previously inadequate treatment of HRT boilers required complete review of available softening methods. A modern internal treatment appeared most advantageous, and this selection is now substantiated from results obtained and shown by typical analyses of the raw water, and of the boiler water after the new treatment has been installed. Company plants include most of the treatment methods available, but it appears that external softening is used principally when plant electric generation requires steam of a quality satisfactory for turbogenerator operation. If steam purity not critical for prime movers, and much of steam used for process and heating, then value of external softening is questioned. Uses to which the steam is to be put is as much a consideration as is the protection of the steam generators. As with other technological advances, new development does not automatically render previous designs obsolete. Careful anal. based upon eng. and economic considerations required to det. most advantageous treatment.—*Author.*

Experiences With Silica Removal Demineralizer Plants. S. B. APPLEBAUM. *Unpublished paper presented at Midwest Power Conference, Illinois Inst. of Technology, Chicago, Ill.* Silica removing demineralizers superseding evaporators for high pressure boiler plants. Brief survey given of research developments in ion-exchange leading to this result. Development traced of sodium, then hydrogen, zeolite to remove alky. in addn. to hardness so as to overcome the difficulties from the use of sodium zeolite alone. Next came use of weak-base anion exchangers which removed sulfates and chlorides but not silica, the fluoride method of removing silica and finally the various strong-base anion ex-

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changers to remove silica. An actual silica removal demineralizer at the Prairie Creek Sta. of Central Iowa Cooperative at Cedar Rapids, Iowa, described. Installed early in 1950 to provide treated make-up water for two boilers rated at 230,000 lb./hr. evaporation at 850 psia. pressure. Evaporators previously purchased were to be used if necessary, but the results from demineralizer so reliable that evaporators not used. Tests run in fall '50 given in detail including log sheet and graphs of results. Even when the cation unit overrun to allow cation leakage, silica did not leak through the anion unit. Final effluent obtained during the test better than guaranteed: total dissolved solids of under 1 to 2.5 ppm. (200,000 to 500,000 ohms) silica under 0.05 to 0.1 ppm., pH value over 8.0. A second installation at Pennsylvania Electric Co., Front Street Sta., Erie, Pa., to be installed in 1951, also described. At first this plant intended to segregate condensate to be fed alone to the 1250 psi. topping boilers and hydrogen-sodium zeolite plant to be installed to feed the 650 psi. boilers. Later the consultants found it more economical to install a demineralizer to feed all the boilers. A rubber-lined vacuum deaerator between the cation and anion stages will remove dissolved O and free CO_2 to prevent corrosion in stage bleeder heaters and feed piping. Fully automatic, 400-gpm. unit has no regenerant measuring tanks. Liquid caustic soda and sulfuric acid to be purchased in tank-car lots to be stored in large steel tanks near R.R. siding and pumped automatically to the unit being regenerated. Instrumentation described, flow diagram included and guaranteed operating results and operating costs given.—*Author.*

Use and Misuse of Organic Water Conditioning Materials. ROBERT W. LIDDELL & LOUIS C. BISHOP. *Unpub-*

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lished paper presented at Midwest Power Conference, Illinois Inst. of Technology, Chicago, Ill. Most troubles with hard scale in boilers have disappeared over the past quarter century due to better external water softening and to internal treatment with phosphate. In some boilers, however, new problem has come up. Instead of a hard scale, much softer sludge may be found in the boiler tubes. Normally harmless, sludge may sometimes become heavy enough to block off a tube completely. With no water circulating through it, tube may then become so hot that it will burst, spewing steam throughout the boiler and forcing shutdown. Sludge trouble may be corrected by several methods. The softening may be further improved, mechanical changes may be made in the boiler to improve circulation and give better mixing of the incoming feedwater with the boiler water or other chemicals may be added to boiler water. Among these other chemicals that may be added to the water are those called "organic," most of them tannins or lignins, byproducts of lumber and paper industries. Several materials even made by specially treating coal. These org. materials keep sludge suspended in water, thus preventing formation of harmful deposits. Often this method of treatment has worked very well. At times, however, more harm than good has resulted, because the org. material either causes boiler water to foam or breaks down in "hot spots" in the boiler and thus forms a scale itself. Just when to use these org. materials is like many other problems in eng. and requires considerable experience, a knowledge of the particular boiler, and a lot of sense.—*Author.*

Boiler Feed Water Treatment. F. J. Matthews. Hutchinson's Scientific and Technical Pubs., London (3rd ed., 1948). In the 3rd, revised, edition of this book on treatment of boiler feedwater new matter added includes use of condensate as feedwater, hot lime-soda softening, sludge contact tanks, continuous removal of sludge from boilers, control of coagulation and softening, and electrical methods of preventing corrosion.—*W.P.A.*

POLLUTION CONTROL

Radioactive Waste Disposal—How Will It Affect Man's Economy? K. G. Scott. Nucleonics, **6**:1:18 ('50). The increasing use of radioisotopes in scientific investigations and for human therapy has given rise to difficulties in disposal of radioactive waste waters. Calcns. show that if the excreta from 50 patients being treated with radioisotopes are dischgd. to the sewers of San Francisco the radio-

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activity in the sludge cake produced at the sewage works will be great enough to be a hazard to health. It is unwise to set a limit to the amount of radioactive waste which may be disposed of to the public sewers by any one user, as in most large urban areas there are generally several institutions which dischg. their waste waters to the sewer. Several possibilities for waste disposal are suggested in Atomic Energy Commission Circular B-6. These are diln. of radioactive materials with stable isotopes of the same element in the same chem. form to prevent reaccumulation after dispersion; dispersion in media such as air or water; confinement and diln. such as the inclusion of radioactive wastes within concrete; and concn. and confinement in storage tanks after the vol. of the waste has been reduced. Radioactive wastes disposed of in the sea may affect life in the sea. Consignment of such wastes to the sea may be safe provided there is fairly rapid diln. in turbulent waters and that reconcn. by biological means does not occur. Biological accumulation of radioactivity in the sea over long periods would involve only the longer-lived isotopes; ulmtiately the radioactive materials will be in equilibrium with the stable isotopes already present in the sea. If a container could be developed that would prevent the diffusion of radioactive materials, then such wastes might be consigned to trenches in the ocean where they will be covered by sediment.—*W.P.A.*

Radioactivity and Water Pollution. R. COLAS. L'Eau, **37**:157 (Nov. '50). After a review of the literature and

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sources of poln. the author concludes that it is necessary to organize protection against danger of atomic wastes rapidly. In addn. to collaboration of hygiene experts studies on hydrologic and hydraulic problems should be made, including currents of surface waters, filters, corrosion, chem. reactions during treatment and leakage. Government, industrial, university and private studies should be coordinated. —*Willem Rudolfs.*

Disposal of Radioactive Wastes From Massachusetts General Hospital. F. A. Butrico. Mass. Inst. of Tech. NP-1623 U.S. Atomic Energy Com., Tech. Inf. Div., Oak Ridge, Tenn. (May 19, '50). A study was made of the dischg. of radioisotopes from the Mass. Gen. Hospital. Measurements were made of the I^{131} dischgd. and ests. were made of the dischg. of P^{32} and C^{14}. It was found that 1.8 curies of I^{131}, about 0.65 to 1.3 curies of P^{32}, and about 10 millicuries of C^{14} were used annually. The amt. of isotope dischgd. would be considerably lower, inasmuch as about 50 to 60% of the administered dose of I^{131} is excreted in 48 hr. Samples were collected on 5 days when flow was the lowest to simulate most hazardous conditions. The concn. of activity dischg. was compared with values proposed in the "Interim Recommendations for Disposal of Radioactive Wastes by Off-Commission Users" (Isotopes Division Circular B-6) and it was found that on 3 days the activity dischgd. exceeded the recommended values. However, NaI was added to the wastes before dischg., thus minimizing the hazard by means of chem. diln. The following conclusions are drawn: [1] I^{131} is dischgd. in concns. exceeding those recommended by the Isotopes Div., [2] for addnl. diln. in the hospital sewer system the radioactive wastes should be dischgd. at times of max. sewage flow, [3] I^{131} wastes were reduced to negligible hazard when dischgd. into Boston Metropolitan sewage system (diln. computed at about 70:1), [4] P^{32} does not constitute a problem at present and [5] C^{14} does not constitute a serious hazard, due to negligible dischg.—*P.H.E.A.*

Design and Maintenance of Septic Tanks for Railway Purposes. D. C. Teal et al. Am. Ry. Eng. Assoc. Bul., **490**:241 (Nov. '50). This report covers recommendations and illustrations for design and operation of small septic tank disposal systems of 200–1,000 gpd. sewage flow and includes recommendations for the design and installation of absorption field, together with bibliography.—*R. C. Bardwell.*

Potomac Basin Zoning Report. West Virginia Water Com. ('48). This report on the Potomac basin is the 2nd of a series compiled by the West Virginia Water Com. The streams in the basin have been classified according to the existing degree of poln. The N. Branch and the main stream of the Potomac R. below the confluence of the N. and S. branches are critically pold. as detd. by the biochem. oxygen demand and contents of dissolved oxygen, coliform organisms and suspended solids. West Virginia and Maryland are both polg. this section of the river, the latter state being mainly responsible. The poln. problem near Martinsburg is discussed and methods of reducing poln. there are outlined. The S. branch of the Potomac is not pold. except for one section. The Shenandoah is in a satisfactory chem. and bact. condition, but the populations of fish are low owing to poln. of the river further upstream. The condition of the Cacapon R. is satisfactory. Tables con-

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taining specifications for the classification of West Virginia streams, statistics of the Potomac and its major tributaries, domestic sewage treatment provided in the Potomac basin and industries and municipalities for which treatment plants are required, and graphs showing the contents of coliform organisms, B.O.D. and D.O. in the rivers of the basin are given in an appendix.—*W.P.A.*

Industrial Waste Waters. Coke & Gas, **11**:240 ('49). A general account is given of the difficulties involved in the disposal of waste waters from gas and coke works and literature on the subject is surveyed. It is considered advisable to remove ammonia, higher tar acids and thiocyanates from the waste waters before they are discharged into the sewerage system.—*W.P.A.*

River Pollution and the River Boards Act, 1948. CHARLES E. SCHOLEFIELD. Wtr. & Wtr. Eng. (Br.), **54**:73 (Aug. '50). One of series of Chadwick public lectures for '50 which serve to commemorate great public works of Sir Edwin Chadwick dealt with problem of river poln. Attempts at preventing river poln. have been going on for 75 yrs. Reforms of mid-19th century began to make serious difference exactly 100 yr. ago. Powerful impetus given to movement by Towns Improvement Clauses Act of 1847. Series of cases followed within few years in Law Reports, dealing with poln. of streams. Public Health Act of 1875 gave local authorities opportunity to take proceedings to protect watercourse from poln. arising from sewage either within or without their dist. Not much use has been made of that section since principal polluters of streams by sewage had been local authorities themselves. Cause of nuisance, which had been serious enough after 1847 when town

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sewerage was matter of local enterprise, was intensified after 1875 when sewerage became compulsory everywhere. At common law, position on industrial pollution of river is same as for other source of fouling: any lower owner who suffered damage by reason of manufacturer putting deleterious matter into stream had right of action for injunction and damages. First statutory provision dealing with industrial fouling of water was confined to gas washings, contained in Gasworks Clauses Act of 1847. Provision was repeated in Public Health Act of 1875, which is still in force. Mfg. poln. was left to Rivers Pollution Prevention Act of 1876, which provided that person causing poln. was not to be deemed to have committed offence if he showed that he was using best means to render flow harmless. Drainage of Trade Premises Act of 1937 regulated position between manufacturer and his local san. authority. By means of act local authority could regulate what they would receive into sewers.—*H. E. Babbitt.*

Aquatic Weed Control With Sodium Arsenite. Kenneth M. Mackenthum. S. I .W., **22**:1062 (Aug. '50). The program is presented as well as the method of application, associated precautions both to workers and water users, and the effects on aquatic vegetation and organisms. The history of the development of a state program in Wisconsin using sodium arsenite as a weedicide is given. Commercial sodium arsenite used in concn. up to 10 ppm. depending upon physical character of the area to be treated. Effectively used in Wisconsin lakes for past 10 years in controlling certain species of aquatic vegetation without deleterious effects to fish.—*P.H.E.A.*

The Hydrogen-Ion Concentration in Streams. Kurt Jaegers. Gesundh.-Ing., **69**:12 ('48). Curves are given which represent the relation between the O_2 content and the pH of a stream. It should be possible to draw conclusions regarding the contmn. of a stream from pH measurements.—*C.A.*

History of Toxic Plankton and Associated Phenomena. T. A. Olson. Sew. Wks. Eng., **20**:71 ('49). Abstract of a paper presented at a symposium on Research Progress in the Field of Water, Sewage, and Industrial Waste, Cincinnati, Ohio. Various historical cases of poisoning of domestic animals by water blooms of blue-green algae described, and exptl. work by various investigators is summarized. D. G. Steyn postulates that two active principles are contd. by the algae, one a liver poison, the other, phycocyan, a photosynthesizing agent which causes skin lesions. A similar,

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but not identical, toxic substance produced by certain marine dinoflagellates is connected with paralytic poisoning by shellfish. Shellfish apparently ingest the organism to such an extent that their flesh, particularly the liver, contains concns. of poisons toxic to man. Recently a hydrochloride of the poison has been isolated. It is suggested that outbreaks of gastroenteritis along the Potomac and Ohio rivers in '30 and '31 may have been caused at least partially by algal blooms. Investigations on the concn. and isolation of the toxic agent of *Microcystis aeruginosa* are now in progress.—*W.P.A.*

Biological Aspects of River Pollution. Nature (Br.), **164**:730 ('49). At a joint session of the Zoology and Botany Sections of the British Assn. in Sept. '49, the biol. aspects of river poln. were discussed. B. A. Southgate described briefly the various types of domestic and industrial waste waters dischgd. to surface waters, and outlined the effect of poln. on surface waters. F. T. K. Pentelow discussed the effects of metallic poisons and of oxidizable organic matter on the fauna of streams. He described the effect of poln. of the Dove R. by copper salts in waste waters from the pickling of copper. Immediately below the point of dischg. the concn. of copper was 1 ppm. and 30 miles downstream it was 0.1 ppm. The number of species and of individual animals living in the pold. area was greatly reduced. Below the point of dischg. of oxidizable org. matter and before decomposition has commenced the effect of the distr. of flora and fauna, including fish, may be very slight. Further downstream when the oxygen tension has been lowered, and sludge has been deposited, "sewage fungus," Tubificidae, and larvae of Chironomidae of the *plumosus* type are found. Below this area, the sewage fungus and the black sludge disappear and other groups of the Chironomidae and leeches, particularly *Herpodella octoculata,* appear. The numbers of Chironomidae and Tubificidae then decline and *Asellus* becomes a dominant species of the fauna. Still further downstream pulmonate molluscs appear, after which the fauna returns to that of unpold. water and fish are usually found. W. H. Pearsall stated that from the botanical aspect, investigations of river poln. have been concerned mainly with attempts to employ different plants as indicators of the stages of org. poln. and of subsequent oxidation. He described the effects of small concns. of org. matter on the algal pop. of a stream. The oxidation products of org. matter, mainly carbonates, nitrates and phosphates, greatly increase the growth of plants and consequently the accumulation of organic muds. The fauna is affected by these muds and by the anaerobic conditions which may be set up. One method of utilizing the compounds of nitrogen and phosphorus dischgd. to surface waters in sewage effluents would be to pass the effluent through shallow lakes containing such plants as *Elodea,* which would grow very rapidly and might be harvested and used as a green manure. H. Jones described the poln. of the rivers of N. Cardiganshire, particularly the Rheidol, by compds. of lead and zinc leached from spoil banks of mines. Addn. of calcium carbonate and superphosphate to the soil in large amts. greatly improved the growth of vegetation by reducing the concn. of available lead and zinc below the toxic level. During recent years the Rheidol R. has been extensively recolonized by aquatic plants; migratory trout and salmon are now found in the river, and fresh water trout have been successfully introduced.—*W.P.A.*

Groundwater Pollution in Michigan. N. Billings. S. I .W., **22**:1596

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(Dec. '50). If certain wastes are not permitted to be put in the streams, they only can be disposed of into the ground. For some wastes this is undoubtedly preferable and even desirable. For others, however, it is very undesirable and incurs the possibility of polg. ground waters. Formerly, it generally was felt that the passage of contmd. water through porous sands and gravels would purify it. This purifying action has its limitation, however. Waters carrying certain offensive tasting, poisonous or otherwise undesirable materials such as some creosote-type compds., chromates, picric acid and common table salt seem to find their way into the ground water reservoirs without becoming purified. It is probably true, also, that many other undesirable substances are not filtered out. The danger associated with the disposal of waste on or into the ground which has been shown in this article does not necessarily imply that all such dumping should be stopped. In detg. the sensible way of handling any disposal problem, several things should be considered: how bad is the material to be gotten rid of, from the standpoint of the damage it can do, what chance the waste has of getting into the ground, what harm the waste is apt to do if it does reach the ground water reservoirs, and where the waste is likely to go after it gets into the ground water.—*P.H.E.A.*

ANNUAL REPORTS

Kansas City (Mo.) Water Dept. Annual Report (Year Ending April 30, 1945). Purif. plant on Missouri R. about 4 mi. north and across river from main business dist. From filtered water reservoir, water pumped through tunnel to reservoirs adjacent to Turkey Creek and East Bottoms pump. stations which deliver into distr. system. Booster sta. supplies high

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level area during max. demand periods. Consumers outside city served chiefly by dists. and private companies which purchase water from city (13.4% of total consumption). Turkey Creek Sta., built in '03 and housing 1 horiz. and 3 vert. triple expansion engines, to be renovated at cost of $835.721, new equip. including 30-mgd. turbine-driven centrifugal pump and 400-psi. boiler. Pop. served 550,000, 422,000 within city; services 81,707, 97% metered; mains 877 mi.; hydrants 10,306. Avg. sta. efficiencies of low, secondary and E. Bottoms stations (all elec.) 74.4, 74.9 and 79.2%, resp. Turkey Creek Sta. duty 82.6 ft.-lb. per 100 lb. coal. Purif. plant, 100-mgd. capac., includes clarifier-equipped basins (4 hr.) for plain settlement, mixing flumes, flocculators (1.6 hr.), settling basins (7.4 hr.), first ⅔ equipped with clarifiers, secondary flocculators (0.8 hr.), final plain settling basins (2.7 hr.), total retention 16.5 hr., and 24 filters. $Fe_2(SO_4)_3$ principal coagulant: alum (< 200 tons), formerly mfd. at plant, purchased because of labor shortage. Filters, operated at 2 gpm. per sq.ft., designed for wash water rise of 24" per min. Latter supplemented by hose surface wash (about 40% total wash water). Avg. filter run 81.8 hr., wash water 1.15%. Avg. turbidity of applied water 8.8 ppm., of effluent 0.4. Chemicals used: lime, soda ash, alum, $Fe_2(SO_4)_3$, Cl, Calgon $(NH_4)_2SO_4$, H_2SO_4, chem. cost per mil.gal. $10.55. Since softening adopted in Aug. '42, effective size of sand increased from 0.469 to 0.544 mm., and uniformity coefficient decreased from 1.535 to 1.207. Anal. of sand coating '42–'45 given, chief constituent $CaCO_3$. Bacterial count per ml., avg. and max., resp., raw Missori R. water 17,900 and 180,000, filter influent 42.1 and 5400, filter effluent 6.4 and 51, plant effluent 7.2 and 67, secondary pumping sta. dischg. 23.5 and 13,500, distr. system 45.4 and 45,000 (high max. in applied, sta. dischg. and distr. system due to pin point colonies). Coliform M.P.N. per 100 ml., avg. and max., raw water, 32,900 and 160,000. Completed coliform positives in 10 ml., plant effluent 0.09%, distr. system 0–0.16%. Latter from mains served by uncovered reservoir, abandonment of which considered. Max. % positive in 10 ml. in any 1 mo. 1.8% and max. std. samples showing 3 or more positive 10-ml. portions in any 1 mo. 1.9%. Hardness reduced from 225 to 115 ppm. avg. (155 max.), dissolve solids from 440 to 350, and color from 15.6 to 7.1. Max. river water turbidity 20,000 ppm., less than 200 ppm. only 10.4% of time. Avg. pH delivered water 10.0. No charge to city for fire protection, street flushing or water used by city depts. Operating revenue $2,642,454, operating expense $1,295,217, depn. $539,045, operating income $808,192, interest $337,850, net income $431,427. Water accounted for by customers' meters 82%. Bonded indebtedness $12,595,000, debt service charges $900,000 per yr. Fixed assets $28,297,405, less depn. reserve $8,798,527, total assets $22,059,369, surplus $8,680,417. Rates 6–17¢ per 100 cu.ft., min. per mo. 50¢, fire protection service $12 per yr., outside city 8–22¢ per 100 cu.ft., min. per mo. 75¢ for ⅝" meter to $82.50 for 12".—*R. E. Thompson.*

Hartford County (Conn.) Metropolitan District Water Bureau. Annual Report (1949). Rates increased by 20% to 18¢ per 100 cu.ft. for first 3000 cu.ft. per day and 9¢ for all in excess, increasing yearly revenue about $300,000. Avg. consumption by 318,000 pop., 32 mgd., 100.6 gpcd. Gross revenue $2,049,342, water sales $1,994,206, operation, maint. and taxes $1,060,021, interest $200,623, sinking

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fund \$313,000, depn. \$308,000, surplus \$156,844. Book value of plant \$35,717,001, depn. reserve \$6,487,203, long term debt \$9,405,000. Electors approved \$10,000,000 appropriation for constr. of dam and appurtenant works on W. Branch of Farmington R. Dist. has 4 reservoir systems, W. Hartford, Nepaug, E. Hartford and Barkhamstead, comprising 8 reservoirs with 42,595 mil.gal. total capac. and 67-mgd. estd. dependable yield. Avg. rate of filtn. (slow sand) 4.16 mgd., max.. 6.8 for limited periods. Color reduced from 19 to 9, bacteria per ml. (20°C.) from 537 to 27 (after chlorination), turbidity from 1.5 to 0.7 ppm. Delivered water: avg. 37° count 17, 9 of 2434 10-ml. portions positive for coliforms, hardness 14 ppm., total solids 35, pH 6.4. Cost of filtn. \$7.38 per mil.gal., of chlorination \$1.11. Filters 14, no. of harrowings 72, washings (Bayard) 15, resandings 3. Cost of power plant operation 2.7¢ per kwhr. Avg. Cl dosage 5.79 lb. per mil.gal. (filtered at automatic plant, and 24 lb. at East Hartford plants (unfiltered). Mains 687 mi., services 44,195, meters 42,874, hydrants 4374, standpipes 4. Cost of meter operation and maintenance per meter in service \$1.03, per meter tested \$4.79 (\$3.66 for labor). Cost of operating 73 vehicles 10¢ per mi., incl. insurance and depn. Rainfall about 5″ below normal. Meter readers avg. about 100 per day. Service discontd. to 3 properties for nonpayment.—*R. E. Thompson.*

Bombay (India). Administration Report (1949–50). Supply from 3 lakes, Tansa, Vehar and Tulsi, 66, 18 and 22 mi. distant, 422, 265 and 457′ el., and 40,660, 9120 and 2295 mil.gal. capac., resp., through steel, c.i., and masonry mains and tunnels up to 72″ diam. Avg. supply 120 mgd., highest on record, of which 113 mgd. to city, or 40.8 gpcd. to 2,771,282 pop. Percentage supplied for domestic purposes 61 (25.4 gpcd.). Rainfall at supply lakes 91–113″, record fall of 30″ in 36 hr. in city, runoff from catchment area 57–70%, evapn. at reservoirs during dry period (8 mo.) 23.23 mgd. Tansa (101 mgd.) and Vehar supplies treated with $(NH_4)_2SO_4$ and Cl. Tulsi supply filtered and treated with Cl, alum and $KMnO_4$. Latter adopted in June '49, substantially reducing Cl required and cost. Treatment cost 5.93 rupees per mil.gal. Of 724 samples from trunk mains, 704 neg. for *Esch. coli* in 100 ml. Majority of poor samples from dead ends—subsequently flushed and chlorinated. Distr. system divided into 3 main divisions, 2 served by reservoirs of 30.5 and 20 mil.gal. capac., and elev. tanks. Hrs. of supply 9, actual times varying in different

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WATCH DOG

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areas. Total quantity used for fire extinguishing 2.98 mil.gal. Pop. increased nearly 100% without corresponding increase in supply and hence short supply complaints increased from 6889 to 11,150. 60 services discontd. for nonpayment; all subsequently restored. Mains 398 mi., services 55,076. Tulsi rapid sand plant (3.5–4 mgd.), constructed in '26 but inoperable due to rapid clogging, placed in service after replacing top sand layer, $\frac{1}{32}''$ grains, with $\frac{1}{16}''$ size, improving qual. of water delivered to suburbs. Income exceeded expenditures by 4,233,333 rupees. Avg. cost of water 3 annas and 8 pies per 1000 gal. Progress report on constr. of dam on Vaitarna R. and conduits and tunnels to L. Tansa included.—*R. E. Thompson.*

Madras Corp. (India) Water Works Dept. Administration Report (1949–50). Supply from Red Hills L., 10 mi. from city, supplemented by 2 infiltration galleries (Sembium and Saidapet areas), both chlorinated, and public and private wells (5000 of latter cleaned and chlorinated). Flood water of Kortalayar R. impounded and conveyed to Cholvaram L. and thence to Red Hills L. The 2 reservoirs, built and maintd. by govt. also supply irrig. water. Corp. pays govt. for water drawn at rate Re. 1/– per 1000 cu.yd. Flood waters also impounded in Poondi Reservoir, 37 mi. from city. Owing to failure of '48 monsoon, daily supply only 13–14 mil.gal until June '49, then gradually increased to 22: avg. 19, 14 gpcd. to 1,400,000 pop., 75% for domestic purposes. Hours of supply and pressure in mains curtailed to conserve supply. Rainfall at Red Hills L. 38.3", 10" less than avg., in '48 only 29.9". Water passed through gravel roughing filters at Red Hills and conveyed by gravity through 2 conduits of 24 and 32 mgd. capac., to slow sand filters (17), chlorination and pumping plant at Kilpauk. To reduce H_2S production in filters, depth of fine sand bed reduced from 28 to 6" and rate increased from 4" vertical per hr. to 8". Efficiency of filters thereby impaired and replacement by rapid sand units being considered. Even 12" sand layer leads to increased H_2S. As alternative to rapid sand filtn., govt. suggested expt. with prefilter consisting of rotating drum covered with micro-mesh stainless steel cloth, but corp. not in favor. Filter cleaning, by contrast, consists of scraping to remove silt, complete removal of 6" of sand and replacement with clean sand, and sterilization of underlayers with bleaching powd.; each filter so cleaned avg. of 8 times during yr. Water chlorinated before and after filtn., avg. dosage 0.94 and 1.46 ppm., resp. Red Hills L. treated with $CuSO_4$ 4 times. City trunk mains 31 mi., distr. mains 376. House services 58,365, of which 4290 metered. Expenditures exceeded revenue by Rs. 20,685. Avg. cost of water Rs. 0–4–3 per 1000 gal. Second masonry conduit, 39,485' long, from Red Hills, also of rectangular cross-section, 6'6" wide with side walls 4' to springing of 2'6" arch and invert dipped 3" in center, completed during yr. Designed for gravity flow, gradient 1 in 5150, capac. 32 mgd. Max monthly samples from distr. system contg. lactose-fermenting organisms in 10 cc. 14%, such organisms found in 10 cc. in Saidapet system in 1 mo. only, and in Sembium in 2 mo.—*R. E. Thompson.*

Arlington County (Va.) Water Div. Annual Report (Year Ended June 30, 1950). Supply, partially repumped, from Dalecarlia Filtration Plant in D.C., operated by U.S. Engineers, through 24 and 36" mains (4 steel pipes, 20", across Chain Bridge) to storage reservoir at Minors Hill.

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South end of county supplied from connection to govt. main near Pentagon Bldg. Avg. purchased ($50 per mil.gal.) 11.27 mgd., max. 16.79. Of 193 meters tested, only 3 unsatisfactory—2% or more fast. Quarterly billing, ⅓ of total on first of each mo. Meters 22,369 (100%). Delinquent accounts 0.012% of service receipts. Main constr. costs, per ft.: 6", $2.62; 8", $3.40; 12", $5.60; 16", $9.26. Hydrants 1634, mains 295 mi. Costs of services installed $43.81 (¾"–⅝" meter) to $1148.82 (6" service and meter). Outstanding indebtedness $271,240, of which $250,000 due Dec. 1, '50. Sinking funds $239,203. Contributions to sinking funds and interest during yr., $47,650 and $12,312, resp. Surplus beginning of yr. $255,173, revenue $1,050,201, expenditures $967,368, surplus end of yr. $338,207. Pop. served 131,000, services 23,052. Min. domestic rate per quarter $4.50.—*R. E. Thompson.*

Amherst (Nova Scotia) Water Commission. Annual Report (1949). Five-yr. program completed. Artesian wells connected to system and found capable of supplying 1.1-mgd. demand. Revenue $58,638, expenditures $65,795, depn. $8820, taxes $9725, interest $5114, capital improvements $79,242, bonds retired $7000, deficit, including latter, $7157. Capital costs to date $520,619, depn. reserve $47,116, sinking fund $19,913, outstanding debenture $155,300, bank overdraft $33,086.—*R. E. Thompson.*

Montreal (Que.) Dept. of Public Works. Annual Report (1950). Since '11, pop. increased about 200,000 per decade, in last decade 300,000, '51 est. 1,450,000. Since war, McTavish Reservoir reconstructed, fourth filter gallery erected, and pipes mfd. for new intake. Latter, consisting of battery of 4 pipes completely encased in concrete and extending to center of St. Lawrence R., being laid in open trench within cofferdam. Completion early in '51. Other improvements under way include modernization of 3 older filter galleries $340,000, extending McTavish pump. sta. $1,200,000, mains from pump. stations to reservoirs $1,400,000, new pumps $300,000. Water flows through intake to 5.5-mi. water works canal, where much of sediment deposited, thence elevated to 64 filters, and finally chlorinated. No statistics given.—*R. E. Thompson.*

East Bay Municipal Utility District, Oakland (Calif.). Annual Report (1950). Dist. created in '23, principal water supply agency for 10 cities and large unincorporated area, total area in excess of 200 sq.mi., total pop. approx. 900,000. Operating income $10,958,584, operating expense $5,277,860, net operating income $5,680,724, after interest payments $3,093,204. Plant value, less depn. $105,255,928, total assets $114,027,958. Bond debt reduced $2,105,000. Original indebtedness $77,000,000, now $51,545,000. Cost to consumer steadily reduced: rate const. since '40. District tax increased 7%, first time in 17 yr., to provide funds for major rehabilitation: tax now 25¢ per $100 assessed valuation, 50% below that in '29. Avg. consumption 109 mgd., more than 142% above '40, max. day 161. Meters 210,026.—*R. E. Thompson.*

OTHER ARTICLES NOTED

Conventional and Upflow Settling Basins. H. S. MORGAN and D. R. MILLER. Eng. News-Record, **144**: 23:34 ('50).

Sulfate-Ion Determination With Benzidine Dihydrochloride. J. W. McCONNELL & R. S. INGOLS. Wtr. & Sew. Wks., **97**:330 ('50).

Metallizing Makes an Old Water Tank Like New. JOHN E. WAKEFIELD. Eng. News-Record, **145**:40 (July '50).


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Service Lines

A meter repair and testing manual has been published by Neptune Meter Co., 50 W. 50th St., New York 20, N.Y., as a guide for meter repair shop practice. The booklet, which is similar in format and content to a predecessor manual issued by Neptune on frost-proof meters, contains detailed instructions for the repair and testing of Neptune meters, as well as general instructions on the layout, conduct and operations of a repair shop.

The Worthington slurry type precipitating softener and coagulator (Type CM) is described in a folder available on request. Address the Worthington Pump & Machinery Corp., Harrison, N.J., and ask for Bul. W-212-B6.

A preventive maintenance program for office equipment is being offered by Remington Rand, Inc., 315 Fourth Ave., New York 10, N.Y. A folder describes the purpose and operation of the plan.

A sizing chart for butterfly valves passing flows ranging from 15 to 10,000 gpm. is being offered by Fischer & Porter Co., Dept. 3940, Hatboro, Pa. A steam valve sizing chart appears on the reverse side.

The complete line of Peerless horizontal Fluidyne pumps is covered by a new 24-p. bulletin now available. The general purpose pumps include two basic types: a close-coupled, electric-motor-driven model; and a bracket-mounted model driven through a flexible coupling, V-belt or flat-bed pulley.

"Chemical Lime Facts" is the title of a new bulletin published by the National Lime Assn., 925 15th St., N.W., Washington 5, D.C. The bulletin, single copies of which are available without charge, is intended for chemists and chemical engineers and contains permanent reference material on the properties—both chemical and physical—and uses of lime.

How $\frac{1}{2}$- to 1-in. continuous weld steel pipe is fabricated at the newest mill of the Spang-Chalfant Div., National Supply Co., Pittsburgh, Pa., is shown in a 32-page bulletin, No. 370. In addition to describing and illustrating the various stages of production of the pipe, the booklet contains tables of weights and dimensions for the pipe.

Polarized field frequency controls for synchronous motors are the subject of a new bulletin available from Electric Machinery Mfg. Co., Minneapolis 13, Minn.

"Health Examinations for Executives" is the title of a booklet issued by the Policyholders Service Bureau of Metropolitan Life Insurance Co., 1 Madison Ave., New York 10, N.Y. The booklet gives the results of a survey of 118 companies conducting regular health examinations as part of a program for conserving the health of their executives. Information on the cost, workings, feasibility and benefits of the program is included.

"Wet Venting of Plumbing Fixtures" is a National Bureau of Standards publication which gives the results of investigations sponsored by the Housing and Home Finance Agency. Copies may be obtained from the Supt. of Documents, U. S. Government Printing Office, Washington 25, D.C., at a cost of 20¢ each. Requests should specify National Bureau of Standards Report BMS119 by J. L. French, H. N. Eaton and R. S. Wyly.

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Unification isn't quite perfect yet. At any rate, when the Navy recently explained that yesteryear's flying saucers were actually huge, high-flying plastic balloons used by the Office of Naval Research in obtaining atom data, the Air Force didn't even wait for comfort to set in before injecting a peevish needle into the proceedings. Only two days after the Navy made its official explanation, two Air Force officers reported seeing a dime-like object hovering "next to" a Navy balloon some 50,000 to 60,000 ft. up in the skies above Alamagordo, N.M.—said object vanishing after "three brilliant flashes, like photo flashes." Then about a week later, an Air Force scientist, well qualified by having last year investigated more than 300 reports of flying saucers when he was head of the Air Force's Atmospheric Composition Bureau, noted that most of the reported saucers were over New Mexico and concluded that they were enemy flying missiles photographing our atom sites. And the Air Force, of course, ought to know, inasmuch as air is its element and as it sends men rather than balloons up to investigate.

What all this has to do with water we aren't quite sure, but don't be too surprised if it turns out that rain is produced by tipping those saucers. And that, of course, *would* be a Navy matter.

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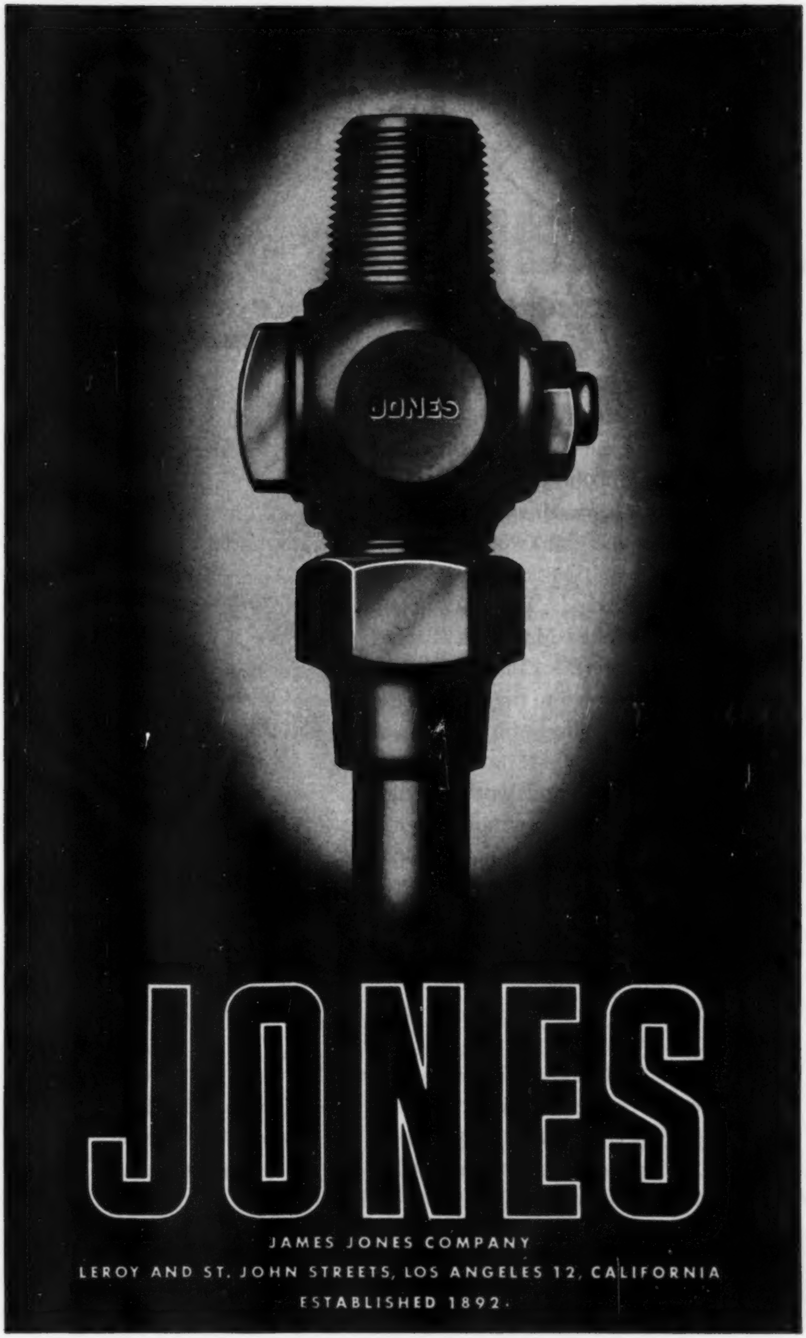
"For Whom the Bell Toils" was the first order of business of the Essex Fells (N.J.) Council the other night, when consideration was given to a request by the neighboring town of Caldwell for the part-time services of Essex Fells' water superintendent. The Bell, of course, is our old friend E. Arthur, whose sphere of influence has now been temporarily extended while Caldwell attempts to replace the retiring Alvin Beck. Not just Art's influence, but his labors promise thus to be expanded—the penalty of fame.

"Penalty of fame," though, reminds us of another "old" friend of ours who doesn't want to pay it. She's Majaji III, rain queen chieftain of the Balobedu tribe of South Africa. Expected, according to tribal tradition, to end her life by swallowing poison when she reached the age of 80, our gal Maj doesn't want to miss the opportunities of octogenarianism. Dry spells and tribe elders to the contrary notwithstanding, Majaji has flatly refused to swallow the draft that done in ten generations of her predecessors on the stroke of 80. And if "it ain't gonna rain no more, no more," there'll always be one of civilization's dowsers to help the Balobedus out.

Meanwhile some other kind of tradition defiance has sent the U.S. Navy rushing to the Virgin Islands—with 250,000 gal. of fresh water to alleviate the drought.



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Section Meeting Reports

New York Section: The Annual Spring Meeting of the New York Section was held at the Hotel Ten Eyck, Albany, April 5 and 6, 1951. Before the meeting, all zone coordinators of the state had an interesting and active discussion of the state's civil defense program. The section has been actively cooperating in this with Civil Defense Coordinator Earl Devendorf. Many problems and plans for the civil defense and mutual aid program were discussed.

W. Victor Weir, A.W.W.A. President, addressed the meeting on the subject of "Controlled Materials." He covered the progress of the efforts of the Critical Materials Committee of A.W.W.A. in its endeavor in Washington to have assigned to the entire water works industry a claimant agency, similar to the plan followed by the gas and electric industry in the National Production Authority. It was expected that some definite action on this claimant agency for water works would be forthcoming shortly. Spencer B. Eddy, public service commissioner, presented a paper on "Relation of Water Utilities to State Regulatory Bodies."

A panel discussion was held on "Civil Defense and Mutual Aid," the progress of which was covered very thoroughly by Earl Devendorf, director. Discussion of "Statewide Problems" was presented by C. R. Cox; "Zone Problems" by James C. Harding; and "Local Defense Problems" by Elon P. Stewart, division engineer of water, Syracuse, for the individual, danger-zone cities.

The usual "Round Table Conference" took place on Friday morning, covering many problems of interest to operators, and was led by S. P. Carman, consulting engineer of Binghamton. An excellent paper on "Control of Tastes, Odor and Color by Excess Chlorination" was presented by Thomas M. Riddick, consulting engineer and chemist of New York.

Following the banquet on Thursday evening, the Rensselaer Polytechnic Institute Glee Club rendered a very fine program. Through the courtesy

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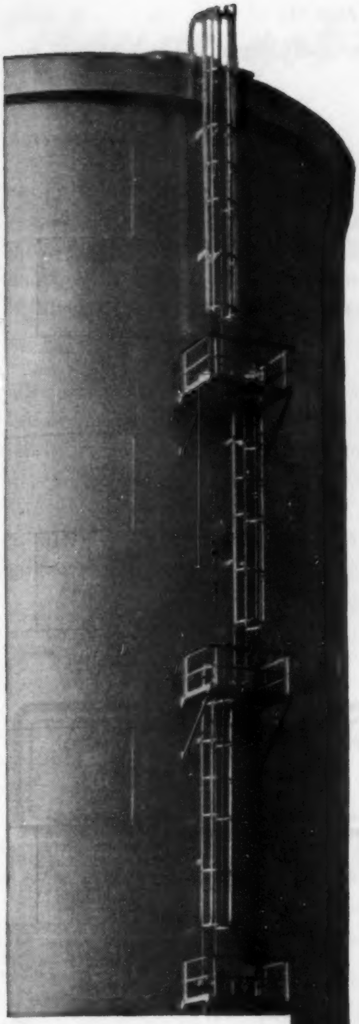

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of the Water and Sewage Works Manufacturers Assn., a Cocktail and Social Hour was enjoyed by all.

R. K. Blanchard
Secretary-Treasurer

An error crept into the report of the Wisconsin Section Meeting, as published in the November 1950 Journal, P&R, p. 84. In his paper, "Bazooka Shooting of Wells," G. L. Smith was attributed with having claimed penetration into the rock formation of 15–20 ft. The figure which should have been given in 15–20 in. The full paper is tentatively scheduled for publication in the June Journal.

Illinois Section: The Illinois Section met March 28–30 at the La Salle Hotel, Chicago, for what the members consider one of their most successful meetings. The attendance was the highest recorded for the section, and the interest of the meeting was due primarily to the efforts of the Program Committee, headed by E. E. Alt.

The papers given during the first afternoon of the meeting were quite varied in their treatment of water works problems and were as interesting

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as they were varied. The kick-off specialist was A. H. Gent, chief engineer of the Illinois Inspection Bureau, who gave a most interesting paper on "Evaluating Fire Protection." Ellsworth Filby, of the firm of Black & Veatch, consulting engineers, followed with a most informative paper on "Water Works Public Relations." H. H. Gerstein, chief filtration chemist, Chicago, gave a paper on "Continuous Odor Monitor and Threshold Tester," in which he described the machine which was set up in the registration foyer (*see* this issue, p. 373). Through the combined efforts of C. W. Klassen and Le Verne D. Hudson, of the Illinois Dept. of Public Health, an interesting treatment was given of a most unusual subject entitled "A New Philosophy in Water Treatment."

Thursday's program was accented by the introduction of leading water works men from states surrounding Illinois. T. E. Larson opened the morning program with a fine paper on "The Ideal Lime-Softened Water." The feature of the morning's program was a round table discussion on "Civil Defense." For the first time in the Illinois Section a bit of feminine charm was introduced into the program as Dr. Henrietta Herbolsheimer acted as moderator for this panel. The panel experts were: Dale Maffitt

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from Des Moines, Iowa; Leon Smith from Madison, Wis.; B. A. Poole from from Indianapolis, Ind.; and H. A. Spafford from Illinois. After the formal presentation by these men, the discussion from the floor was most encouraging, and lunch was delayed half an hour because of the interest displayed. The business meeting which followed was featured by short and precise reports by all committee chairmen.

The afternoon session proved just as interesting as the morning's. Secretary Harry Jordan discussed the "Availability of Water Works Materials." Louis Ayres, consulting engineer from Ann Arbor, Mich., and head of the A.W.W.A. Water Rates Committee, gave an excellent paper on "Water Rates." A panel discussing the "Maintenance and Repairs of a Distribution System" featured such experts as A. Kuranz from Waukesha, Wis., Clifford Fore from Mt. Vernon, Ill., S. Merz from Rockford, Ill., and F. C. Amsbary from Champaign, under the able leadership of A. Anderson from Springfield. The discussion held the attention of a very large audience until just before the cocktail hour.

Friday morning's papers continued on the high level of the previous two days. J. B. Stall discussed "Reservoir Silting in Illinois." J. Fortin

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discussed "Balancing Water Works Budgets," and L. Gayton of Chicago gave a most interesting paper on how and why Chicago furnishes its water to the outlying municipal districts.

As previously stated, the success of the formal meetings was due to the excellent program. There is always the light side of the program, however, which adds so much to the meetings. This entertainment consisted of a clubroom type cocktail party, followed by entertainment at the banquet, and all parties returned to the clubroom for additional frivolity. This entertainment was arranged by the able Lindy Harper, and all agreed that this was one of the best shows the section has ever had.

The espionage activities of the Polish Countess Maria Pulaski were a feature of the dinner program. The caricatures, drawn by one of the city's leading artists, were an added feature of the evening's entertainment. Dancing and stunts continued until well past midnight.

After three days the participants of this meeting returned to their respective communities more tired but better informed than when they arrived and, it is believed, a bit happier.

J. Leslie Hart
Secretary-Treasurer

Index of Advertisers' Products

A complete Buyers' Guide to all water works products and services offered by A.W.W.A. Associate Members appears in the 1950 Membership Directory.